DIV. OF FISHES

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COMMERCIAL FISHERIES Review

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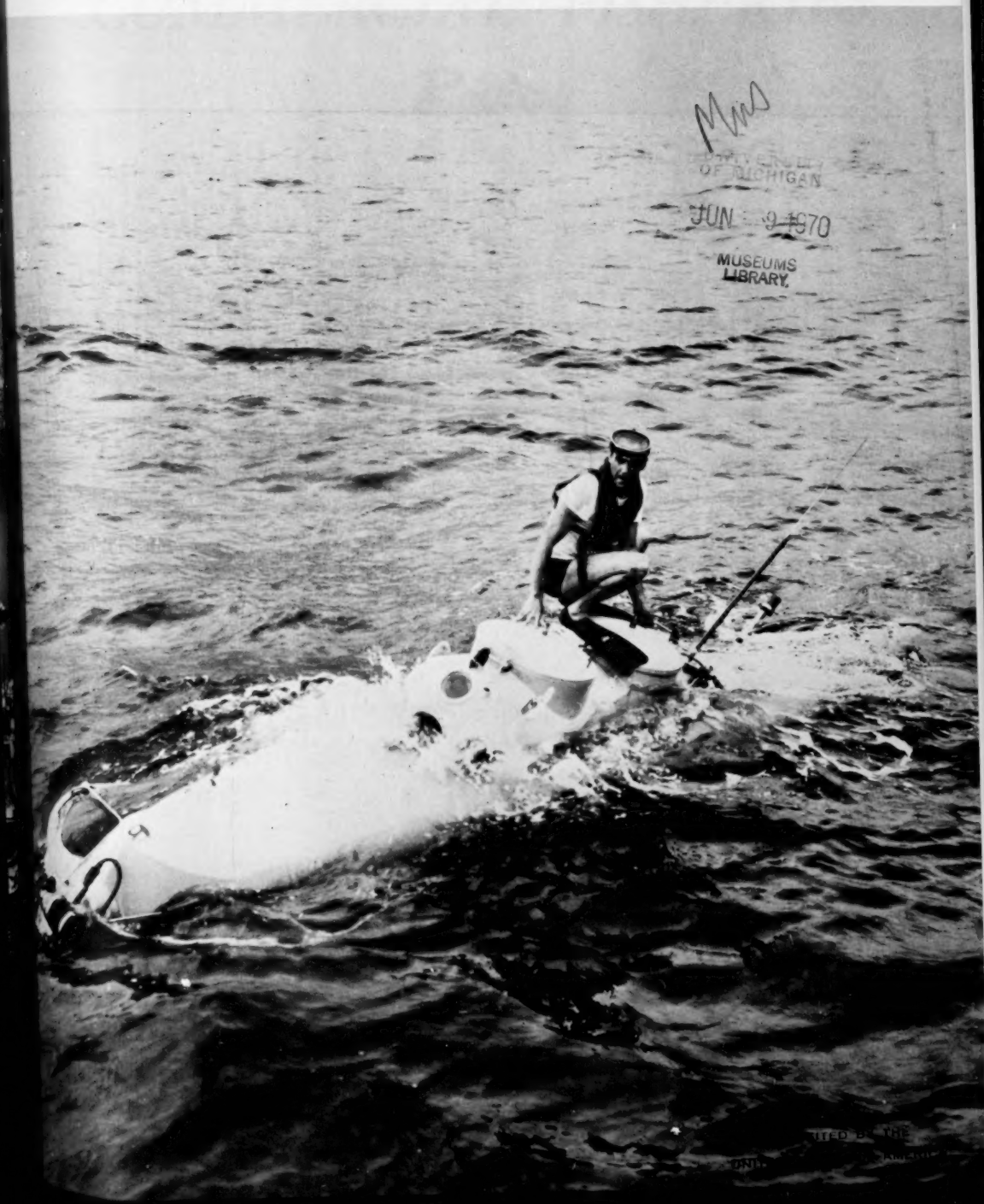

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COVER: 'Perry Cubmarine' on 1969 scallop survey off Cape Kennedy, Florida. (L. May)

COMMERCIAL FISHERIES

Review

A comprehensive view of United States and foreign fishing industries--including catch, processing, marketing, research, and legislation--prepared by the Bureau of Commercial Fisheries.

FISHERMEN'S MEMORIAL--GLOUCESTER, MASS.

DEPOSITED BY THE
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Throughout this book, the initials BCF stand for the Bureau of Commercial Fisheries.

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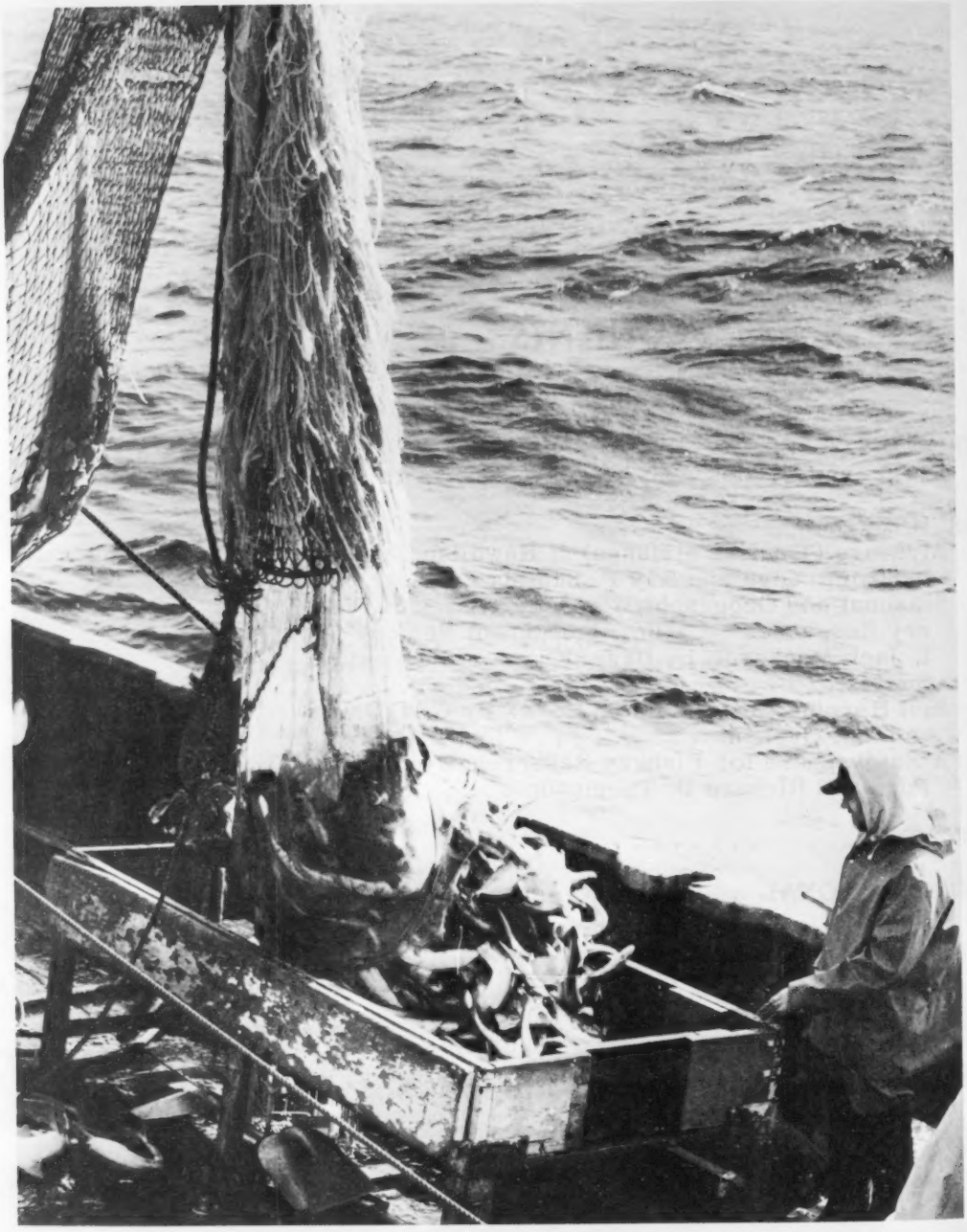


Unloading catch aboard BCF's 'Albatross IV'. (R. K. Brigham)

FORECAST GROUNDFISH ABUNDANCE ON NEW ENGLAND BANKS

The abundance levels of groundfish species fished by New England fishermen are expected to show patterns of change in 1970, reports Russell T. Norris, Director of BCF's North Atlantic Region.

- Haddock and whiting are expected to continue at low levels of abundance.

- Cod, ocean perch, and industrial fish species are expected to equal or exceed 1969 levels.

- The yellowtail flounder has been at high level, but there are signs of somewhat lower abundance in the next years.

Information by BCF Biologists

These forecasts were based on information provided by biologists of BCF's Woods Hole (Mass.) Laboratory. They normally monitor landings by commercial fishermen. They also study populations of fish and shellfish on offshore banks by samples taken by BCF's 'Albatross IV.'

Georges & Browns Bank Haddock

The vessel's annual fall groundfish survey showed 1969 year-class of haddock was poor on Georges Bank. It was the sixth continuous year of very low indexes. As a result, low abundance was expected to continue for at least three years.

On Browns Bank, the survey showed abundance of 1969 year-class haddock had improved over previous years. Because of previous poor year-classes, however, abundance was expected to decrease for the next three to four years.

ICNAF Conservation Measures

As conservation measures for haddock on Georges and Browns Banks, the International Commission for the Northwest Atlantic Fisheries (ICNAF) has instituted catch quotas and closed seasons. It is hoped these measures will aid recovery of depleted haddock stocks off New England.

GEORGES BANK HADDOCK SPAWNING IS WATCHED CLOSELY

The success of haddock spawning on Georges Bank and Browns Bank again is being followed carefully by biologists of the BCF Woods Hole Biological Laboratory and Canadian Biological Station, St. Andrews, New Brunswick.

The Georges Bank area is of particular interest this season. It used to be the primary producer of haddock, but now the population is at an all-time low. Haddock born in 1963 and age seven in 1970 are still the mainstay of the Georges Bank fishery. Haddock-spawning studies underway at the Boston Fish Pier and aboard research vessels surveying the fishing banks could provide earliest evidence of the emergence of a large year-class.

General Conclusions

By frequent examination of samples of haddock gonads, it has been possible to monitor the progress of spawning--and to draw these general conclusions about the duration of the spawning season on Georges Bank:

1. The largest haddock spawn first, usually in shoal water on top of the banks, both inshore and offshore.

2. Prior to onset of spawning, ripening haddock of all sizes are found in deep waters along Northern Edge of Georges Bank and in South Channel. The maturity of fish from deep water usually is one or two stages behind those from the shoals.

3. Ripening of fish and their movement from deep water seem associated with seasonal warming of bottom waters. However, this does not explain the early spawning of large haddock on the shoals.

4. The number of immature haddock in the samples has decreased steadily since sampling began in 1968. Less than 2% of fish sampled through March 1970 have been immature.

BCF LOOKS FOR BLUEFIN TUNA

"Bluefin tuna are great travelers," confides BCF La Jolla, Calif. Fish tagged and released in the California fishery have been recaptured several years later off Japan. During late spring, the bluefin visit the waters off southern Baja California. In 1969, U.S. fishermen caught 7,500 tons of the highly prized fish.

Waiting for the bluefin this year as they approached the coast were oceanographers and fishery biologists of the BCF La Jolla laboratory and the Scripps Tuna Oceanography Research program (STOR). They had left San Diego on April 13 aboard BCF's 'David Starr Jordan', led by Dr. Maurice Blackburn of STOR, on a 21-day, 4,100-mile cruise. Its purpose, explained Dr. Alan R. Longhurst, director of BCF La Jolla, was to give the tuna industry up-to-date information on the oceanographic mechanisms that determine routes of bluefin tuna into the coastal region--hence, the location the fishery would open in 1970.

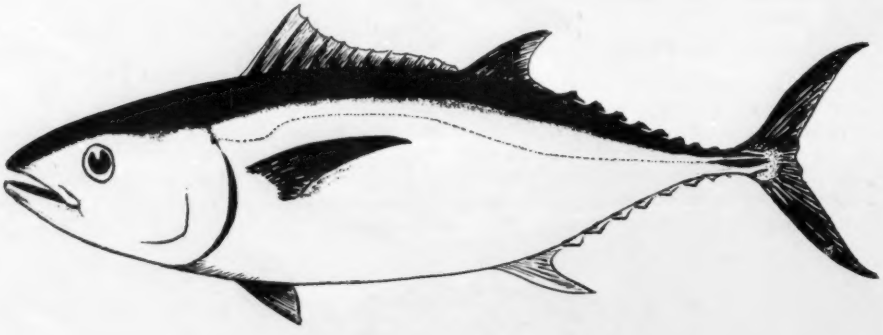
Equipment Used

Ninety percent of bluefin tuna are caught in 62°-70° F. water, beginning in late May each year. Almost nothing else is known about their environmental preferences.

The scientists hoped to locate offshore bluefin by longlining, basing the fishing tracks on the long-term mean position of the 62° and 70° isotherms. They were using a battery of oceanographic, biological, and meteorological instruments to measure the ocean environment--and to attempt to relate findings to tuna fishery.

Early Information Important

The information on bluefin distribution weeks before they normally reach Baja California has immediate practical value to U.S. tuna fishermen. These fishermen were looking for alternate resources because the yellowfin tuna quota had been filled for 1970. Locations of any bluefin catches would be radioed to La Jolla by the David Starr Jordan. The information would be passed on to southern California tuna fishermen.



AMERICANS EAT MILLION POUNDS OF SHRIMP A DAY

In 1968 and 1969, Americans ate a million pounds of shrimp a day. In 1969, consumption of shrimp in all forms was 361.6 million pounds, heads-off weight. This was a drop of 1.3% from 1968's record 366.2 million pounds. Nevertheless, shrimp remained unchallenged as the most popular shellfish.

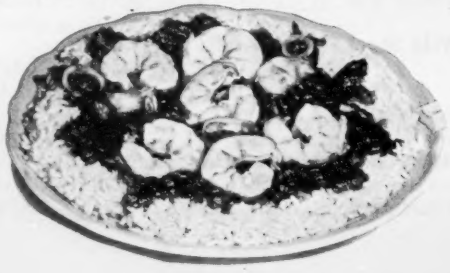
On a per-capita basis, Americans are eating about twice as much shrimp as they did in years immediately following World War II.

Reasons for Growth

BCF economists say no single answer explains why Americans are eating more shrimp. Contributing factors have been rising purchasing power, growing popularity of shrimp, new products, wider distribution, improved quality, and more promotion.

U.S. Shrimp Industry

The U.S. shrimp industry is located primarily in the Gulf and South Atlantic States. Additional supplies come from New England, Pacific Coast, and Alaska. The U.S. also imports large quantities. In recent years, Latin American and Asian countries have supplied larger quantities.



BROWN SHRIMP REARED IN ARTIFICIAL MEDIA

Techniques for rearing larval penaeid shrimp that were developed at the BCF Biological Laboratory, Galveston, Texas, continue to pay dividends. In a recent experiment, about 250,000 brown shrimp were reared to postlarvae from eggs spawned in the laboratory. Survival rates of up to 84% were observed as the young shrimp developed from the naupliar to the postlarval stage.

Maintained in 250-gallon tanks, one batch of shrimp was cultured in a completely defined medium consisting of distilled water with an artificial sea salt added. This technique interests scientists working with larval shrimp nutrition because of the possibility that the larvae may absorb organic molecules directly from the water. It also provides a method of culturing shrimp larvae that can be duplicated at any laboratory--and is not dependent upon unknown characteristics of the water.

Greater Densities Obtained

Cultures of the diatom Skeletonema, used as food for the larval shrimp, were maintained in tap water and the artificial sea salt. Densities of 8,000,000-10,000,000 cells per milliliter of water were obtained. Previously, maximum densities were 300,000-500,000 cells per milliliter in natural sea water. The variable chemical nature of the sea water used previously made it difficult to obtain optimum concentrations of the nutrients utilized by the diatoms.

Of all postlarval shrimp harvested, about 100,000 were supplied to five organizations involved in research on shrimp mariculture.

HAWAII'S COMMERCIAL FISH LANDINGS DROP BUT VALUE RISES

Commercial landings of fish and shellfish in Hawaii during the 1968-69 fiscal period totaled 11,096,116 pounds worth $3,378,553 to the fishermen--a decrease of 1,733,210 pounds, or 13.5%, from previous year. However, generally better prices prevailed, so exvessel value rose $124,931 (3.8%).

Ups & Downs

The lower total harvest was due largely to decreased landings of aku (Katsuwonus pelamis). These dropped 1,453,033 pounds, or 16.1%. Other important fisheries fell too: yellowfin tuna (Neothunnus macropterus) by 108,262 pounds (23.3%), akule (Trachurops crumenophthalmus) 215,826 pounds (20.8%), and striped marlin (Makaira audax) 172,572 pounds (35%).

Fisheries that increased were: bigeye tuna (Parathunnus sibi) by 95,552 pounds (19.5%), and opelu (Decapterus pinnulatus) by 53,811 pounds (27.7%).

Oahu Led

Oahu led the islands in landings with 9,027,407 pounds, or 81.4% of total State landings, followed by Hawaii, 897,134 pounds (8.1%), Maui with 847,269 pounds (7.6%), Kauai 282,830 pounds (2.5%), and Lanai and Molokai combined, 41,476 pounds, 0.4%.

PRAWN CULTURE IN HAWAII PROGRESSES

The development of techniques to mass-rear the giant, long-legged, fresh-water prawn (shrimp), 'Macrobrachium rosenbergi', continued in Hawaii during July 1968-June 1969. This was reported to Governor Burns by the Department of Land and Natural Resources.

During that year, 700,000 juvenile prawns were produced--500,000 more than in the previous year. The planners believe this "demonstrates that sufficient numbers of young prawns can be propagated to supply commercial prawn farmers." They are concentrating now on reducing production costs from $6.47 per thousand to about $2.

Fishpond Owners Cooperate

The number of privately owned fishponds cooperating with the Division of Fish and Game to test-rear young juveniles to market size rose from 2 to 9. The ponds are ¼ to 6 acres; combined surface area is about 10 acres. About 207,000 juvenile prawns were stocked. The use of supplemental feed improved growth rate of pond-raised prawns. It used to take 2 years to raise a prawn from egg to market size; now, just over 1 year.

Wild Stocks

In continuing attempts to establish wild stocks, 128,000 prawns were released into streams throughout Hawaii.

DR. GLASGOW URGES ADOPTION OF EFFECTIVE FISH DISEASE CONTROL PROGRAM

Dr. Leslie L. Glasgow, Assistant Secretary, Fish and Wildlife, Parks, and Marine Resources, U.S. Department of the Interior, testified before the Energy, Natural Resources, and Environment Subcommittee of the Senate Commerce Committee, March 13, on the need for a fish disease control program.

Dr. Glasgow said:

Efforts to control fish diseases in this country were begun a century ago by Spencer Fullerton Baird, the first Commissioner of the U.S. Commission of Fish and Fisheries. In 1898, the Commission requested Congress to authorize a full time fish pathologist. In 1915 the position was authorized and the study of fish diseases has been an important function ever since. The Bureau of Sport Fisheries and Wildlife in 1968 expended 380,000 dollars on fish disease research and 120,000 dollars on fish disease control in national fish hatcheries. Yet these are minuscule amounts in relation to the total values of our fish resources.

Value of Hatchery & Pond Fish

In 1966 alone, the Pacific salmon and steelhead trout caught by commercial and sport fishermen were valued at 28.5 million dollars. At least 55% of the salmon and steelhead catch originated in either a State or Federal fish hatchery. Commercial hatcheries in 1968 produced 18 to 20 million pounds of trout valued at 11 million dollars. In the South Central States fish farmers produced 40 million pounds of channel catfish valued at 12 million dollars, and 40 to 50 million pounds of bait minnows valued at 50 million dollars are produced annually. The stocking programs carried out by State and Federal fish hatcheries provide one third of the sport fishing in the United States and result in 943 million dollars being spent for recreation with a total contribution of 3.9 billion dollars to the gross national product of the United States.

Fish Resources Threatened

As the industry continues to grow, the lack of attention to matters of fish health on both the state and national level brings us to the point where our fish resources are threatened by uncontrolled diseases.

There are a number of serious fish diseases, some of which are causing losses in the United States, and at least two diseases, currently rampant in Europe, that have not been introduced into North America. These diseases include whirling disease, infectious pancreatic necrosis, viral hemorrhagic septicemia, corynebacterial kidney disease, infectious hematopoietic necrosis, virus disease of channel catfish, Ceratomyza infection of salmonids, Minchinia infection of oysters, microcell disease of mollusks, molluscan neoplasm disease and French mycelial disease of oysters.

Whirling Disease Closes Hatcheries

Whirling disease has had a serious impact wherever it has occurred. Authorities in Pennsylvania report that this disease caused the closing of five commercial trout hatcheries which had a combined production worth over 250,000 dollars wholesale. The hatcheries were forced to close because the disease had infested the ponds to the point where, without expensive rehabilitation, they were useless for further production of trout.

In New Jersey, whirling disease had been a problem since July 1967. Brook trout production at a major State installation was reduced by 40 percent and expensive changes in hatchery operations were required.

The recent confirmation of whirling disease in the State of Michigan caused the Department of Natural Resources to impose on August 30, 1968, a quarantine on all fish-rearing firms in the State. Investigations are still in progress and there is concern that the disease might spread to the highly popular coho salmon in the Great Lakes.

Even closer to home, whirling disease was found at the Lahontan National Fish Hatchery in November 1969. We will have to destroy three quarters of a million cutthroat trout. In addition, we have lost 12,000 cutthroat broodstock. It took us ten years to develop this broodstock. The Lehontan cutthroat trout is considered an endangered species by the International Union for Conservation of Nature and we regret having to take such drastic measures with an endangered species.

Infectious Pancreatic Necrosis

The Bureau of Sport Fisheries and Wildlife has records of outbreaks of infectious pancreatic necrosis from at least 23 States, several Provinces of Canada, and from France and Denmark. The disease directly affects the output of commercial, State and Federal fish hatcheries whenever it occurs. Following an outbreak, facilities must be disinfected and the fish must be replaced. If the fish are replaced with eggs, a delay of several months in the production program is encountered. This is a great setback, particularly for the small commercial producer. Egg producers are especially hardhit when IPN occurs since, in most cases, valuable broodstocks must be destroyed and a loss of consumer confidence often results.

Interior's Authority Fragmentary

The existing authority of the Secretary of the Interior to control fish diseases is fragmentary.

The Lacey Act of 1900 gives the Secretary the authority to regulate the importation of fish and wildlife to protect the resources of the United States.

Under the Lacey Act, Title 50, CFR, Part 13.7 was revised on December 21, 1967, to prevent the introduction of two fish diseases into this country.

The Black Bass Act of 1926, as recently amended in 1969, prohibits importation or transportation in interstate or foreign commerce of fish in violation of foreign, State, or other law.

The 1934 Fish and Wildlife Coordination Act, as amended in August 1958, authorizes the Secretary to provide assistance to and cooperate with Federal, State, and public and private agencies and organizations in the development, protection, rearing and stocking of all wildlife resources and in controlling losses from disease.

The Act of March 15, 1958 (16 U.S.C. 778-778c) authorized the Secretary of the Interior to establish fish farming experimental stations to conduct research on methods of fish farming including the control of fish diseases. Two such stations have been established in the Bureau of Sport Fisheries and Wildlife.

The Act of September 2, 1960 (16 U.S.C. 753a-753b) authorized the Secretary of the Interior to enter into cooperative agreements with colleges and universities, with State game and fish departments, and with nonprofit organizations, relative to the establishment of research and training programs for fish resources. There are 23 cooperative fishery units operated by the Bureau of Sport Fisheries and Wildlife.

The Act of August 9, 1962 (16 U.S.C. 760j-7601) authorized the Secretary of the Interior to assist the States in developing disease resistant oysters. The Bureau of Commercial Fisheries now operates this and other disease control programs under PL 88-309. Under the disaster clause of this law, the State of Michigan received 65,000 dollars to control whirling disease, but a similar request by the State of California for 400,000 dollars to control a virus and a parasite disease at a State hatchery was denied because of a shortage of funds.

Senate Bill Useful

None of the above Acts was specifically intended to promote the control of fish diseases, and all of these collectively are still inadequate. S. 1151 includes in one piece of legislation the authority to set up and operate an effective fish disease control program.

The bill authorizes the Secretary of the Interior to:

(1) Control the interstate traffic of diseased fish.

(2) Inspect premises and conveyances.

(3) Compensate the owner for fish which must be destroyed.

The bill also instructs the Secretary to prepare regulations to:

(1) Control the traffic of diseased fish.

(2) Set up methods whereby fish diseases can be eradicated.

Under such authority I believe that the menaces of fish diseases can be effectively reduced and finally eliminated. We urge early enactment of this legislation.

HICKEL PLEDGES LAKE ERIE CLEAN-UP

Secretary Walter J. Hickel announced on April 21 that Interior Department was initiating a campaign to clean up Lake Erie. This followed reports of lethal discharges of mercury into the lake--and into the Detroit River, which empties into Lake Erie.

He said he was distressed by the economic losses and possible health hazards to residents of Lake Erie area by mercury contamination of fish.

Secretary Hickel moved on these fronts:

• An enforcement conference on Lake Erie will be reconvened in Detroit. It will be followed by enforcement workshops in Toledo, Cleveland, Lorain, Dandusky, and Ashtabula, Ohio; Erie, Pennsylvania; and Lackawanna, New York.

• Increased monitoring and research will begin on the toxicity of mercury and other metal compounds, and their effect on fish and other aquatic life. The work will be done by BCF Ann Arbor, Michigan.

• The Federal Water Quality Administration (formerly Federal Water Pollution Control Adm.) has been directed to identify and list all toxic substances being discharged into U.S. waters.

CONFERENCE ON ENVIRONMENTAL POLLUTION SCHEDULED

The Department of the Interior will sponsor a 4-day conference and exposition on environmental pollution at the Sheraton Park Hotel in Washington, D.C., Sept. 29-Oct. 2.

Secretary Walter J. Hickel said the conference was being called in response to President Nixon's call for "a total mobilization" to clean up the environment.

More than 3,000 leaders from industry, government, national organizations, and universities are expected to participate.

Hickel's Statement

Secretary Hickel said: "In his message to the Congress on the environment on February 10, President Nixon said that the task of cleaning up our environment calls for a total mobilization of all of us--involving governments at every level and requiring the help of every citizen.

"We hope to make this conference a productive answer to the search for new and more efficient methods, approaches, and techniques for winning the battle for a better national environment.

"Our purpose is not only to focus national attention on the threat to our environment but to help muster a nationwide effort in corrective actions to improve it."

Exhibits

At the concurrent national exposition, the participating groups will be invited to display pollution abatement equipment, techniques, and services.

MAN COMPETES WITH OTTER FOR ABALONE

Wallace Turner

(This article appeared in The New York Times May 10.)

In San Francisco, a waterfront diner raises a bite of the succulent, delicately flavored shellfish to his mouth and chews dreamily as he gazes out at the boats bobbing in the swells.

A hundred miles or so to the south, a sea otter slumps comfortably on his back as he rides the swells of the open sea and with quick, tiny bites rips through the rubbery flesh of the same kind of shellfish.

They are competing, the sea otter and the gourmet, for a dwindling population of abalone, a prized shellfish that grows amid the kelp beds on the rocky sea floor along the central California coast.

To the competitors themselves, the abalone simply means choice food. But both sides have allies in the turbulent world of conservationist and economic pressures, and to them serious issues are at stake.

Seek Thinning of Herd

Working for the gourmet are the divers who walk the sea floor in search of the abalone and the processors who slice the meat and pound it for tenderizing. They have sought legislation to permit the thinning of the otter herd as a means of protecting the abalone fishery.

And speaking for the small furry sea animals is Margaret Owings, president of Friends of the Sea Otter, a group demanding that nothing be allowed to interefere with the natural growth of the otter population.

Mrs. Owings, the wife of Nathaniel A. Owings, the architect, directs her campaign from Wild Bird, one of the nation's most stunning homes, designed by her husband and built on a point hundreds of feet above the surf of Big Sur.

From her balcony she can see a crescent of sand that is a sunning place for a herd of sea lions and a kelp bed that is home for a half-dozen sea otter. Gray whales pass sometimes just outside the kelp.

'Man and Wildlife'

"We're not just dealing with otter," Mrs. Owings said in a recent interview. "We're dealing with the whole question of man and wildlife. If we lose this one, we've lost a foothold on future attempts to preserve a rare species."

Far to the north, a larger band of sea otter wanders around Amchitka Island in the fog, cold and gloom of the outer Aleutian chain. It feeds heavily on sea urchins, who have no friends.

The smaller herd to the south, regenerated from a few individuals that escaped the fur hunters of the 18th and 19th centuries, now number about 1,500 between Morro Bay and Monterey.

They are increasing at the rate of 4 to 6 per cent a year, and they are gobbling up the abalone. Mrs. Owings argues that a part of the decrease in abalone comes from overharvesting by divers, but she agrees that "we know perfectly well that the otter like abalone."

The divers who go down in bulky suits, trailing yards and yards of rubber hose, to pry the abalone from the rocks have great respect for their rivals' fishing skill.

'Don't Waste Any Time'

"I remember the first time I saw an otter break an abalone with a rock," said Ernest Porter, who has been diving for about 20 years. "They don't waste any time with it. They get a rock, and just like a carpenter nailing a board, they know what to do with it."

The Pacific coast abalone grow large enough for their edible portions to weigh as much as five or six pounds. But the seven-and-three-quarters inch size that may be harvested commercially usually produces about two to two-and-a-half pounds.

"Of course the sea otter doesn't understand about the limits," said Dr. H. G. Orcutt,

laboratory supervisor for the California Fish and Game Department. "He eats any abalone he can get."

The abalone has an oval shell top and travels on a snail-like "foot" that holds it to rocks, along which it moves, slowly feeding on the leaves that fall from the kelp.

While divers must use a steel bar to pry it free, the sea otter simply takes a rock and breaks the shell so that the abalone loses its grip and can be carried to the surface and eaten.

Hunt Other Shellfish

The otter also hunt other shellfish. They break clams open by banging them together until they crack, and they handle a dungeness crab by holding one pinching claw while eating the other, then eating the one that was held, and then ripping off the bottom shell to clean out the crab's insides.

The otter live in a cold sea. They lack the fat layer that protects the sea lion, harbor seal or whale, but they have a thick fur that they constantly preen to prevent heat loss.

And they eat. A sea otter will consume his weight of 45 to 75 pounds in shellfish in three or four days. After a complex calculation, and allowing a wide margin for variables, Mr. Odemar, the fish and game biologist, estimated that one herd of 97 otter in one year ate between 627,800 and 1.15 million pounds of abalone.

There is no question that the supply of abalone is disappearing. The divers maintain that abalone disappear wherever the otter population is found as it moves slowly southward from the fastnesses of the rugged coast along Big Sur. In 1957 divers limited themselves to 50 dozen each a day; now getting five dozen abalone is a struggle.

The divers work in water 20 to 70 feet deep, in a cold that after a couple of hours penetrates their black rubber suits, the lining and their bones so that they must go topside and warm up.

Water Rough All Year

The water here is rough the year around.

"Sometimes a surge in the waves will throw you 60 feet and up against the rocks," said Duane Brown, 35 years old, who five years ago left a dough mixing job in a Phoenix, Ariz., bakery to be an abalone diver.

He worked for eight hours that day to have about three hours on the sea bottom, and he brought back about $41 worth of abalone. He dived alone, too, which means that any serious accident would have been fatal.

Charles Sites, who operates an abalone processing plant, pays $18 a dozen for abalone. He said there were no more than 10 abalone boats, with about 20 divers, working out of Morro Bay now. In 1960 there were more than 50 boats.

"The otter have moved south and they just clean up the abalone," he said. The diving now centers near Santa Barbara, but divers here maintain that the otter will spread there and wipe out the marketable shellfish.

Abalone Sure to Survive

Biologists for the State Fish and Game Department say that the abalone species will not be wiped out, for they spread too many eggs for that. But they agree that a commercial fishery cannot exist alongside an unlimited herd of sea otter, who eat the abalone before they reach marketable size.

State Senator Donald L. Grunsky, who represents this area at Sacramento, introduced a bill this year that would have allowed state biologists to capture and try to move the otters to keep population down.

After hearings at which Mrs. Owings and other friends of the otter testified, he asked that his bill be turned into a study proposal, which means the end of it for now.

Charles Sites' wife spoke in good humor of "our group that we called Friends of the Abalone."

"We had a little money and opened a checking account, and a while back we wrote a check for $10 and it bounced," she said. "We'd forgotten about the service charges."

RENOWNED SCOTTISH MARINE BIOLOGIST VISITS BCF OXFORD LAB

Dr. C. Maurice Yonge, a world leader in marine biology, toured BCF's Biological Laboratory at Oxford (Md.) on April 13 and presented an informal seminar.

Dr. Yonge holds the Regius Chair of Zoology at the University of Glasgow, Scotland. He is president of the Scottish Marine Biological Association. He received his doctorate from the University of Edinburgh in 1922 for original studies of food and feeding in 'Mya arenaria'--the U.S. common soft-shell clam, or mannose.

His research career began at the Plymouth, England, marine biological lab where he studied metabolism in the European oyster.

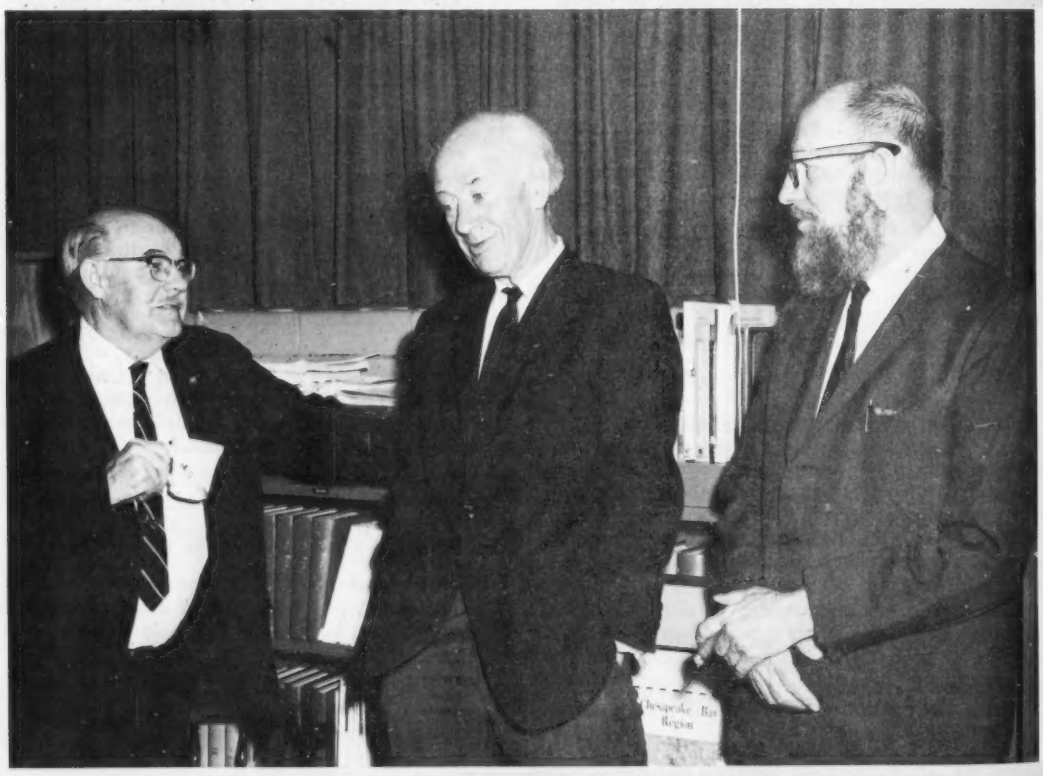
In the late 1920s, he led an expedition to Australia's Great Barrier Reef. It resulted in significant contributions to marine science and the founding of the Heron Island lab for continuing reef studies. He has worked at marine stations all over the world.

Classics of Marine Biology

Dr. Yonge's two most famous books, "The Oyster" and "The Sea Shore," are classics. The results of his research have influenced the direction of modern invertebrate biology. He is now interested in the relationship between the shape or anatomy of marine bivalves (oysters, clams, mussels) and their ability to adapt to the environment.

Oxford Seminar

His seminar at Oxford reviewed the world status of molluscan culture, or sea-farming. He related the development of aquaculture to biological events. He used personal observations from more than 20 visits to the U.S. and Canada as examples of dynamic changes in the shellfisheries.



James B. Engle, Chief, Shellfish Advisory Service (left), Dr. C. Maurice Yonge (center), and Arthur S. Merrill, Laboratory Director, BCF Biological Laboratory, Oxford (right).

This was Dr. Yonge's first visit to the Eastern Shore and he was impressed by its natural beauty and by the ever-present artifacts of the Bay fisheries. He was fascinated by the similarities between small U.S. villages, such as Oxford, and coastal villages in England.

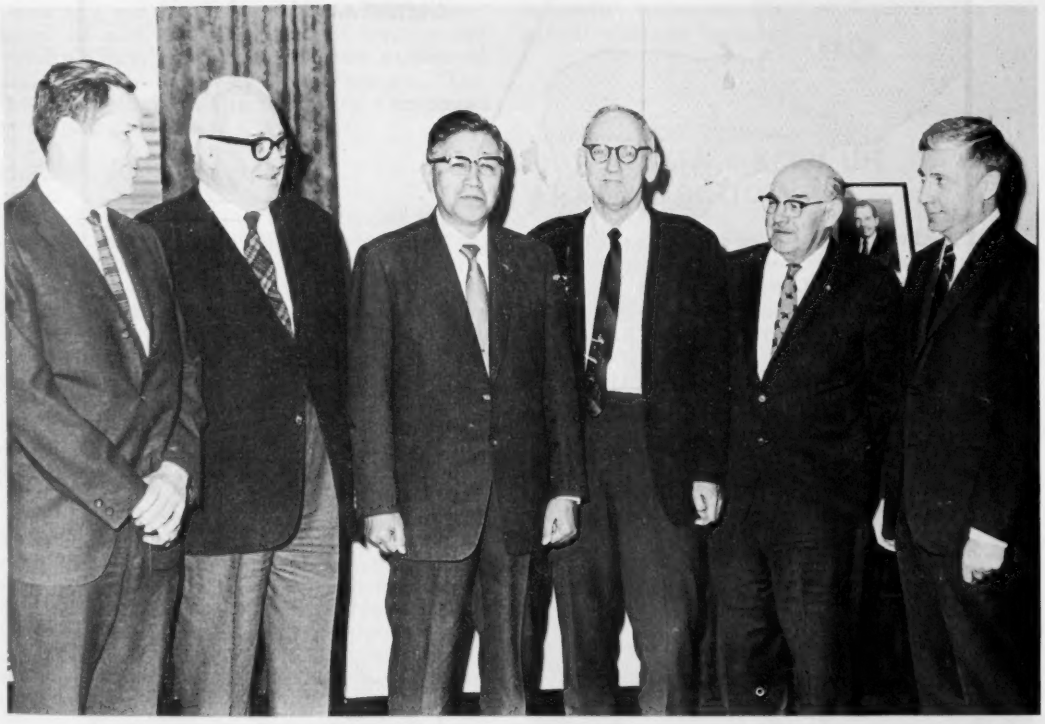
Dr. Yonge lauded the European oyster as "the best in the world"--but he admitted the possibility that the U.S. oyster might be second best!

JAPANESE SHELLFISH AQUACULTURE AUTHORITY VISITS U.S.

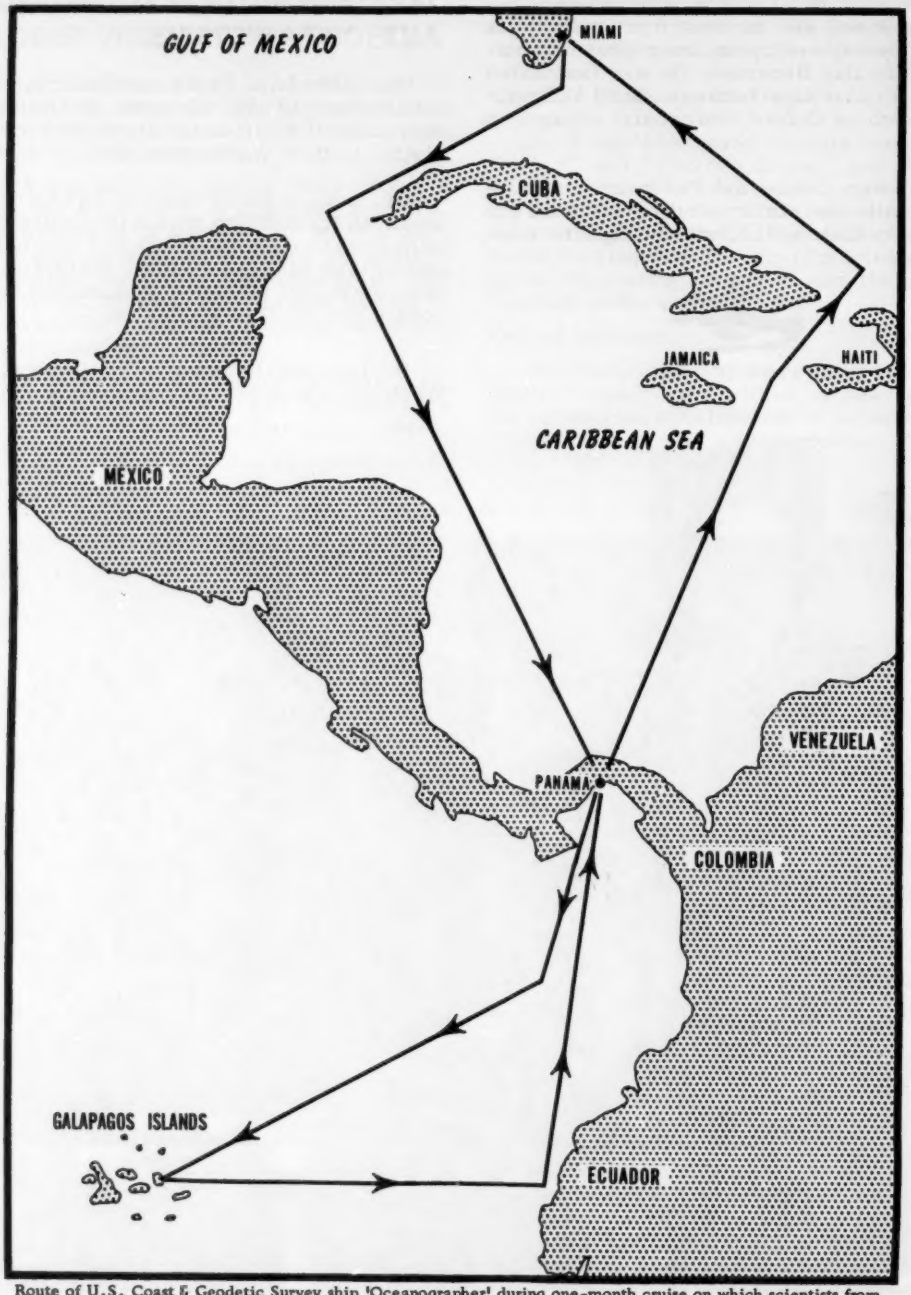
Dr. Takeo Imai, Professor Emeritus Tohoku University and Director of Oyster Research Institute in Sendai, Japan, was a recent visitor to BCF Washington, D.C.

Dr. Imai, a world-famous authority on shellfish aquaculture, was in the United States primarily to study the effects of warm-water effluents on shellfish culture. He toured Federal, State, and industry installations on both coasts and the Gulf of Mexico.

Dr. Imai also lectured at the University of Washington's School of Fisheries in Seattle.



L to R: William N. Shaw, BCF, Oxford, Md., Neal Kelly, HEW, Washington, D.C., Dr. Takeo Imai, William M. Terry, Acting Deputy Director, BCF, Washington, D.C., James B. Engle, BCF, Oxford, Md., William Davis, BCF, Washington, D.C.
(Photo: Bob Williams)



Route of U.S. Coast & Geodetic Survey ship 'Oceanographer' during one-month cruise on which scientists from nine nations will attempt to establish an international standard for measuring ocean phenomena.

OCEANOGRAPHY

9 NATIONS SEEK STANDARDS TO MEASURE OCEAN & ATMOSPHERE

On April 30, 25 scientists from 9 nations sailed from Miami, Fla., aboard the 'Discoverer' to the Gulf of Mexico, Caribbean Sea, and Pacific Ocean in a 1-month attempt to establish international standards for measuring ocean and atmospheric phenomena. The Discoverer is an oceanographic 'floating laboratory' of the Coast and Geodetic Survey.

The scientists are oceanographers, physicists, and meteorologists from the U.S., the Soviet Union, Australia, Denmark, France, Japan, Norway, Great Britain, and West Germany.

Sea and air experiments are being conducted in and over the Gulf of Mexico and Caribbean Sea, and in the offshore waters of South America southwest of Panama. The ship will return to Miami via the Caribbean and the Sargasso Sea.

Measuring Sea's Productivity

Scientists from the U.S., Soviet Union, Australia, Denmark, France, Japan, Norway, and Great Britain are measuring the ocean's primary productivity. Essentially, this is a measure of the rate phytoplankton utilize radiant energy from the sun and nutrients from the sea to produce carbohydrates, oxygen, and other products through photosynthesis.

Incoming radiation at sea's surface and several levels below will be measured, together with the water's optical properties.

By bringing together scientists, measuring devices, and techniques from different countries, the planners aim to develop a means for intercalibrating the results--so measurements can be compared on an international basis. If a technique is agreed upon, it will be recommended to scientists throughout the world concerned with measurement of the sea's productivity.

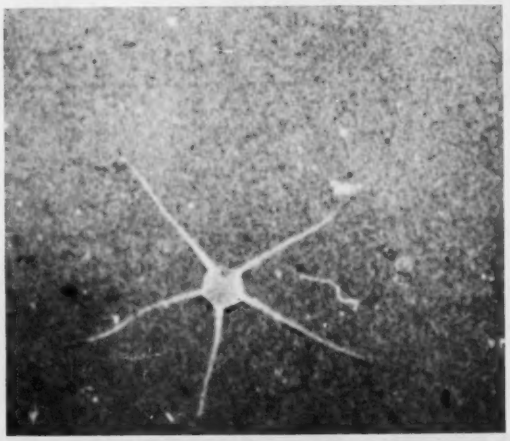
Measure Radiation in Atmosphere

Meteorologists and technicians from the U.S., Soviet Union, Japan, and West Germany are attempting a comparable intercalibration of radiometersondes they use to measure radiation in the atmosphere. The instruments, carried aloft by helium-filled balloons, radio back to the ship data on variations in radiant energy versus height above sea. Instruments of the 4 nations fly from the same balloon. So the scientists are measuring the same thing and will be able to intercalibrate their equipment.

The radiometersondes are measuring the thermal radiation emitted upward and downward from the atmosphere, and upward from the sea. As the balloons rise, the instruments gather data to provide a vertical profile of the variation in radiation. The radiation is emitted by water vapor, carbon dioxide, ozone, dust, and ice crystals in the atmosphere; radiation increases in intensity as temperature increases. Such data are considered vital for a useful understanding of what drives the global weather "machine."

PHOTOGRAPH MARINE LIFE AT ARCTIC BOTTOM

J. H. Kravitz, a geologist at the U.S. Naval Oceanographic Office (NOO) has presented photographic evidence that there is marine life even in near-freezing conditions on the bottom of Arctic waters. NOO says it probably was the first time it has been photographed.



Starfish live on Arctic bottom.
(Photo: U.S. Naval Oceanographic Office)

Kravitz reported: "We have a picture of brittle stars and starfish living on the sea floor at a point about 30 miles west of Franz Josef Land." He and 5 other scientists aboard the Navy icebreaker 'Atka' reached the far northern point in early autumn. At that season, the Arctic ice pack surrounding the 70 Franz Josef Land islands--all lie above western USSR in Barents Sea--yields somewhat to warmer temperatures.

Camera Near Sea Bottom

"But, even then, we had to ward off ice flows and small icebergs called 'growlers' to get this shot," Kravitz recalls. The camera system was lowered about 1,000 feet to a point about six to nine feet above the bottom. Then it was activated long enough to get 61 pictures "before the ice forced us to cut the camera run short and abandon the site." The photo on page 13 shows the marine animals living on a "rather smooth, tranquil bottom" close to the freezing point--0.52 degrees centigrade.

May Be First

According to Kravitz, the photo may represent "the first time scientists have ever used a camera aboard an icebreaker, or any surface ship for that matter, to photograph the ocean floor this far north, although photographs of the Arctic Basin have been taken from floating ice islands."

GULF OF MEXICO 'ESSENTIALLY SAME' AS 100 MILLION YEARS AGO

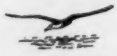
"The Gulf of Mexico is essentially the same now as it was 100 million years ago." That was the conclusion of scientists who completed Leg Ten of the Deep Sea Drilling Project.

"We found nothing in the Gulf to support or deny the theory of continental drift," said Dr. J. Lamar Worzel, Associate Director of Columbia University's Lamont-Doherty Geological Observatory in Palisades, New York. "Our findings do deny any continental drift occurring there for about the past 100-135 million years. Beyond that I cannot say, but up to that time the deep basin was there and existed in essentially that same environment and location as it does today." Dr. Worzel was co-chief scientist with Dr. William R. Bryant, Texas A & M University, College Station, aboard the research vessel 'Glomar Challenger' during the cruise across the Gulf of Mexico from Galveston, Texas, to Miami, Fla.

A Theory About Gulf

Some geologists have theorized that the Gulf of Mexico once had been shallow and had sunk. Their estimates of when this happened range from 10 million to over 100 million year ago.

Scripps Institution of Oceanography, University of California at San Diego, is managing the Deep Sea Drilling Project under contract to the National Science Foundation. The Project is a part of the Foundation's Ocean Sediment Coring Program.



STUDY PESTICIDES DISCHARGED BY MISSISSIPPI R. INTO GULF

In April, researchers aboard the University of Miami's 'John Elliott Pillsbury' sampled and analyzed hydrocarbon pesticides in the water and bottom sediments of the Mississippi River delta and similar estuarine areas along the Gulf of Mexico's northeast coast.

Dr. Eugene F. Corcoran, Chief Scientist, said: "The Mississippi River is grossly modified as it flows nearly 2,500 miles from its beginning in a small lake in Minnesota to the Gulf of Mexico by the agricultural, industrial, and urban activities of a large complex society. When the river system discharges into the Gulf of Mexico, it carries with it much of the man-made pollution resulting from these activities. An important part of our expedition will be to show how the contaminated effluent is dispersed in tne deep waters of the Gulf of Mexico, and what effect it has on the chemical and biological production in these areas."

The expedition also gathered information on the pesticide content of water taken from the Mississippi River delta for human consumption.

Chlorinated Hydrocarbons

The pesticides studied included DDT, dieldrin, aldrin, endrin, toxaphene, lindane, chlordane, and heptachlor. Almost insoluble, and extremely resistant to microbial degradation, these compounds can persist almost indefinitely in the water. They are also the most toxic to higher forms of aquatic life.

In addition to pesticides, the researchers also measured the salinity, oxygen, inorganic phosphates, nutrients, and trace metals at each sampling station.

U.S. COAST PILOTS 1 & 3 WILL BE UPDATED

The Coast and Geodetic Survey (C&GS) announced in late March that it will inspect navigational facilities and conditions between Eastport, Maine, and Cape Cod, Mass., and between Sandy Hook, N. J., and Cape Henry, Va., including Delaware and Chesapeake Bays.

Findings will be incorporated into new editions of "U.S. Coast Pilot 1, Atlantic Coast, Eastport to Cape Cod," and "U.S. Coast Pilot 3, Atlantic Coast, Sandy Hook to Cape Henry," scheduled for 1971. Eight of the nautical books are issued by C&GS; new editions are published at intervals of four to ten years.

The Information Furnished

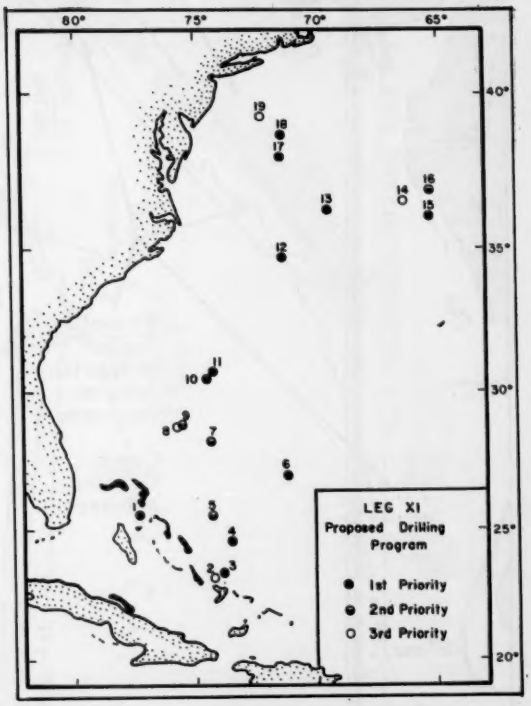
Generally, the books furnish in narrative form information that cannot be shown graphically on marine charts--navigation regulations, weather, ice, freshets, routes, and port facilities.

Coast Pilots and the annual cumulative supplements that keep them up to date are used by skippers of naval and commercial craft and by small-boat operators.

SPLIT OF EUROPE & N. AMERICA AGES AGO STUDIED

Deep-sea sediment now being recovered by the research vessel 'Glomar Challenger' during Leg Eleven of the Deep Sea Drilling Project is expected to produce scientific information on what happened millions of years ago when North America and Europe were pulled apart. Leg Eleven began in Miami, Fla., April 7, and ends in New York May 31.

Scientists are interested in what happened to the earth's crust as the continents tore apart. A major objective of the drilling is the investigation of this event by examining the oldest sediments in the Atlantic Ocean deposited when the continents separated.



FOREIGN FISHING OFF U.S. IN MARCH 1970

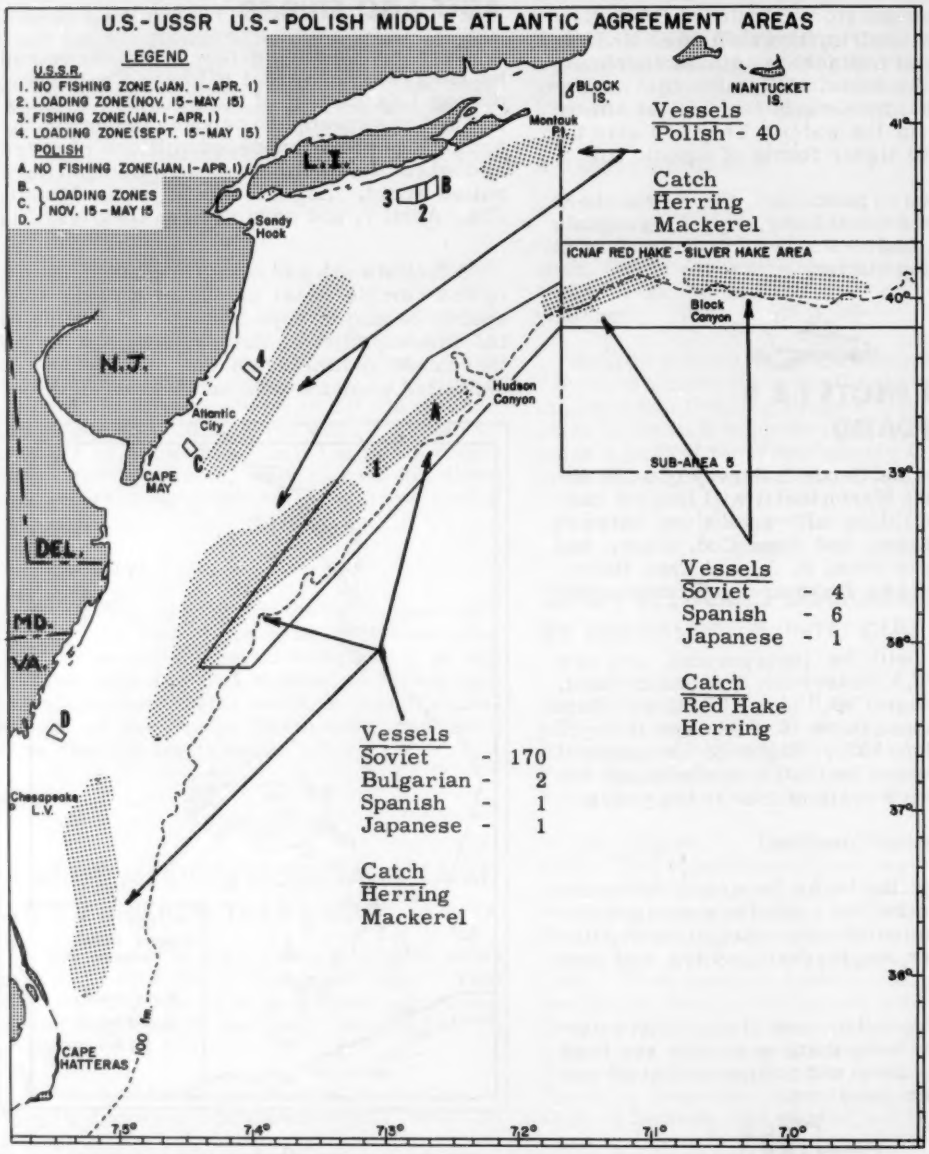


Fig. 1 - Foreign-flag vessels fishing off southern New England and Georges Bank, Mar. 1970 (shows no. of vessels and species fished).

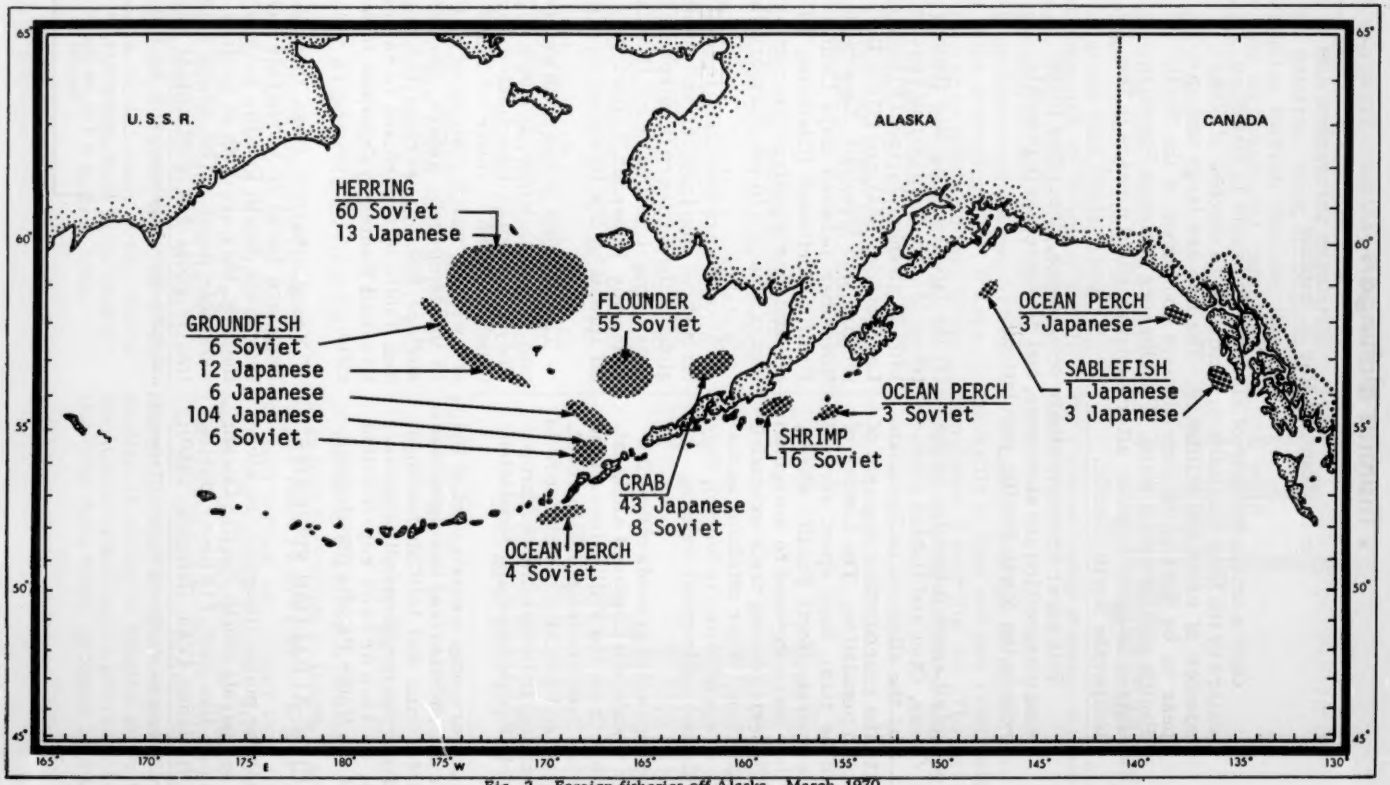


Fig. 2 - Foreign fisheries off Alaska, March 1970.

ALBACORE OF HAWAIIAN WATERS

• Thunnus alalunga •

Tamio Otsu and Ray F. Sumida

Only a small quantity of albacore is caught in Hawaiian waters by the long-line fishery, incidental to catches of other species of tunas and billfishes. The fish are large and appear to be part of the reproductive component of the North Pacific albacore population. The albacore arrive in Hawaiian waters in early summer after spending about 6 years in the temperate North Pacific.

This paper documents their occurrence, describes their size composition and abundance, and discusses their possible role in the North Pacific population.

In their model of albacore migration in the North Pacific Ocean, Otsu and Uchida postulated in 1963 that the albacore in Hawaiian waters belong to the reproductive segment of the North Pacific population. The history of the fish would be this: they spent several years in the temperate North Pacific where, alternately, they were exposed to American and Japanese fisheries during their extensive east-west migrations. After attaining sexual maturity at about age 6 (90 cm. in length), they migrated south into subtropical waters.

The inferred spawning grounds of the albacore extend in a wide belt centered along lat. 15° N., and reach from the Philippines in the west to about the Hawaiian Islands in the east. Thus, say Otsu and Uchida, the albacore in Hawaii are probably the easternmost component of the North Pacific spawning population.

The albacore are only a small part of the landings of Hawaiian fisheries: in weight, less than 3% of total tuna and billfish landings. Though relatively scarce, these albacore are, nevertheless, an important reproductive component of the North Pacific population.

NORTH PACIFIC ALBACORE FISHERIES

There are three major fisheries for albacore in the temperate North Pacific Ocean: (1) the Japanese live-bait fishery during April-July off Japan (Van Campen, 1960); (2) the Japanese long-line fishery during October-March from Japan east to about long. 170° W. (Nankai Regional Fisheries Research Laboratory, 1954); and (3) the U.S. west coast trolling and live-bait fishery during June-November between Baja California and the Pacific Northwest (Clemens, 1955). These account for virtually all the commercial landings of albacore in the Northern Hemisphere.

Albacore are also taken in small quantities throughout the tropical and subtropical regions of the Northern Hemisphere by the Japanese long-line fishery (Nankai Regional Fisheries Research Laboratory, 1959), and off Hawaii by the Hawaiian long-line fishery.

The albacore in Hawaiian waters are found only at great depths, perhaps 150 or 200 m. They are taken by deep-fishing long-line gear (Yoshida, 1966)--unlike albacore in temperate waters, which also occur at the surface. In the temperate waters, they are taken by surface fishing: surface trolling and live-bait fishing by Americans in eastern Pacific, live-bait fishing by Japanese in western Pacific.

Young albacore (less than about 90 cm. long) are found in temperate latitudes. In temperate North Pacific, between Japan and the U.S., they are both at surface and at considerable depth. The adults migrate south into tropical and subtropical waters, where

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Fish and Wildlife Service
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they are exclusively at great depths (Otsu and Yoshida, 1967). The fisheries are geared to take advantage of this unwavering regularity in the fish's life pattern. Thus, throughout the tropics, including Hawaii, the long-line method is the only way known for capturing these deep-swimming albacore.

The Fleet and the Catch

In Hawaii, the long-line fishery operates mostly in "inshore" waters; boats range in size from 5 to 38 gross tons (Hida, 1966). In 1950, the fleet consisted of 76 boats; not all fished full time. The number has dwindled steadily since then and, by 1968, only 22 boats operated. The boats have crews of two to five men and make trips averaging about 9 days. Although most fishing is within 40 km. of the main Hawaiian Islands, a few boats occasionally have ventured as far as 500 km. from port. A new long-line vessel, the 'Kilauea', joined the fleet in 1969. She has made regular trips to fishing grounds 500 to 800 km. south of Honolulu.

The principal long-line catches in Hawaiian waters are the bigeye tuna, Thunnus obesus, and the yellowfin tuna, Thunnus albacares. Among the billfishes, the Pacific blue marlin, Makaira nigricans, and the striped marlin, Tetrapturus audax, are the most abundant. Less abundant species are the broadbill swordfish, Xiphias gladius; sailfish, Istiophorus orientalis; shortbill spearfish, Tetrapturus angustirostris; black marlin, Makaira indica; wahoo, Acanthocybium solandri; skipjack tuna, Katsuwonus pelamis; dolphin, Coryphaena hippurus; and the albacore.

More detailed descriptions of the Hawaiian long-line fishery are found in June (1950), Otsu (1954), Shomura (1959), Hida (1966), and Yoshida (1966).

LANDINGS OF ALBACORE IN HAWAII

The annual landings of albacore in the Hawaiian long-line fishery in 1948-68 ranged from 3 metric tons in 1965 to 48 metric tons in 1952 (fig. 1); these accounted for 0.4 to 3.0% of total tuna and billfish landings (table 1). The catches were relatively higher in earlier years of study period, 1948-53, when 23 to 48 metric tons were landed each year. Since then, however, the landings have been considerably lower: less than 13 metric tons.

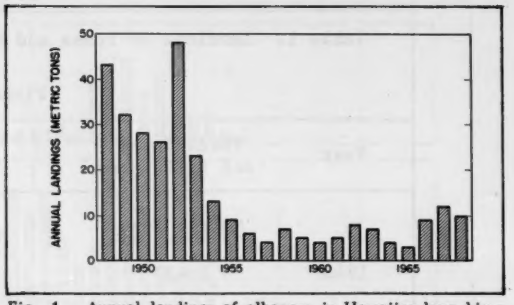

Fig. 1 - Annual landings of albacore in Hawaiian long-line fishery, 1948-68.

Monthly landings of albacore increase markedly in June and are relatively good for remainder of year (fig. 2). The best catches, however, are between June and October.

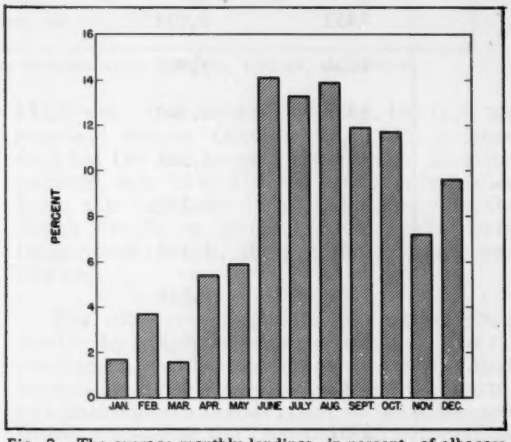

Fig. 2 - The average monthly landings, in percent, of albacore in Hawaiian long-line fishery, 1948-68.

SIZE COMPOSITION OF CATCH

The albacore taken in Hawaii are generally large fish; they range in length from about 85 to 130 cm. (14 to 44 kg.). Eighty percent of the fish landed are longer than 100 cm. (21 kg.). The males are larger and more numerous than the females. The average length in 1965-68 was 102.2 cm. for females and 106.0 cm. for males; the males outnumbered females 1.9 to 1. There has been a marked decline in albacore lengths since the 1950s. Because so few albacore are landed each year, the size data were grouped into three time

Table 1. Landings of Tunas and Billfishes in the Hawaiian Long-line Fishery, 1948-68[1/]

Year	Total Tunas and Billfishes	Total Albacore	Albacore Landings
	Metric Tons	Metric Tons	Percent
1948	1,435	43	3.0
1949	1,419	32	2.2
1950	1,787	28	1.6
1951	1,811	26	1.4
1952	1,876	48	2.5
1953	2,032	23	1.1
1954	1,985	13	0.7
1955	1,540	9	0.6
1956	1,511	6	0.4
1957	1,198	4	0.4
1958	1,236	7	0.6
1959	1,218	5	0.4
1960	1,016	4	0.4
1961	926	6	0.7
1962	976	8	0.8
1963	865	7	0.8
1964	939	4	0.5
1965	849	3	0.4
1966	817	9	1.1
1967	798	12	1.5
1968	704	10	1.5

1/Data obtained from State of Hawaii, Division of Fish and Game Statistics, Annual Summary, and may include small amounts of tunas and billfishes taken by methods other than the long-line.

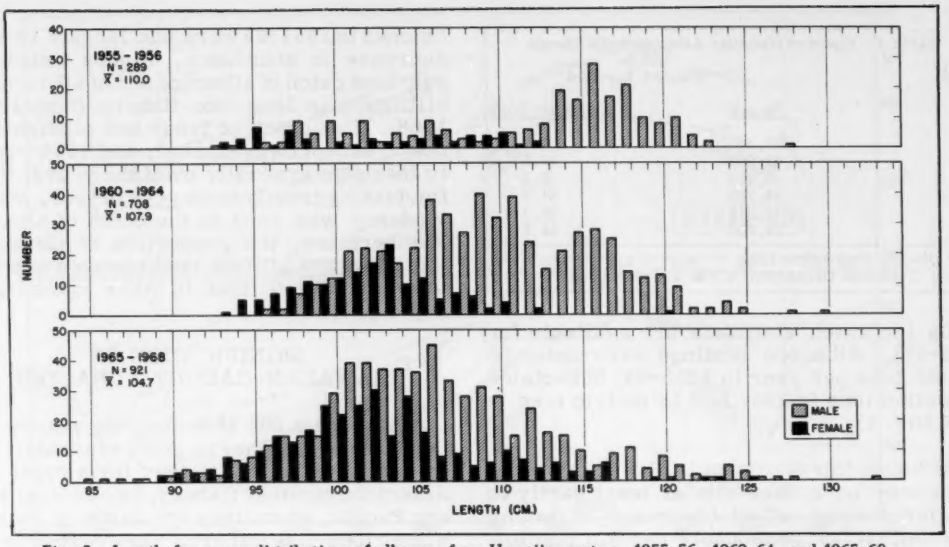

Fig. 3 - Length frequency distributions of albacore from Hawaiian waters, 1955-56, 1960-64, and 1965-68.

periods: 1955-56, 1960-64, and 1965-68 (fig. 3). No data are available for 1957-59 because the Honolulu markets were not sampled then. The average length (sexes combined) of 110.0 cm. in 1955-56 decreased to 107.9 cm. in 1960-64, and to 104.7 cm. in 1965-68. This decrease is even more striking when males are considered separately. The modal sizes decreased from about 116 cm. in 1955-56 to 109 cm. in 1960-64, and to about 105 cm. in 1965-68. There was no reduction in mean size of females over the years.

An outstanding feature of the albacore taken in Hawaii is their very large size; in fact, they are generally larger than those taken anywhere else in the Pacific. Otsu and Uchida reported in 1959 a 127.6-cm. (42.2 kg. or 93 lb.) male as the largest albacore landed in Hawaii in 1955 or 1956. Since sampling was resumed in 1960, four unusually large specimens (all males) have been recorded (table 2). The longest (taken July 21, 1966) measured 132.7-cm. and weighed 40.8 kg. (90 lb.); the heaviest (taken October 25, 1965) weighed 44.5 kg. (98 lb.; length, 128.4 cm.). In comparison, only 22 of 373,754 albacore sampled from the Japanese long-line fishery in the North Pacific in 1949-59 (Suda, 1963a) were longer than 120 cm.; the maximum length was 124 cm.

Table 2 - Records of the Five Largest Albacore (All Males) Taken by the Hawaiian Long-line Fishery and Sampled at the Honolulu Markets Since 1955

Date	Length	Weight
	Cm.	Kg.
July 8, 1955	127.6	42.2
June 26, 1964	129.7	44.0
September 28, 1964	128.2	37.2
October 25, 1965	128.4	44.5
July 21, 1966	132.7	40.8

The albacore caught throughout the South Pacific by long-line vessels based at American Samoa are also considerably smaller than Hawaiian. They are believed to be the Southern Hemisphere counterpart of the albacore, which appear in the tropical and subtropical regions of the North Pacific (Otsu and Yoshida, 1967); populations in the North and South Pacific are believed to be separate. The albacore taken in the fishery based at American Samoa average about 90 cm. in length (16 kg. or 35 lb.). The largest caught in 1968 (in January, at lat. 18° S., long. 171° W.) was 113 cm. long (31 kg. or 68 lb.).

APPARENT ABUNDANCE

Because albacore have been uncommon in the landings of recent years, it is surprising to learn that Hawaii exported albacore to California in the late 1920s and early 1930s (table 3). These exports, probably not the entire catch, indicate that landings were considerably greater then. The relatively good catches may have continued into the early

Table 3 - Export of Hawaiian Albacore to California

Year[1/]	Amount Exported	
	Pounds	Metric Tons
1928	57,500	26.1
1929	43,054	19.6
1930	5,426	2.5
1932	98,720	44.9
1933	43,612	19.8
1934	25,900	11.8

1/No albacore exported in 1931.
Source: California Department of Fish and Game, 1937.

1950s (no catch statistics are available for 1935-47). Albacore landings were under 10 metric tons per year in 1955-66, but totaled 12 metric tons in 1967 and 10 metric tons in 1968 (fig. 1).

Although this decrease in Hawaii albacore catch may have been due at least partly to smaller fishing effort (decrease in fishing vessels), it is reasonably certain that low catches in 1954-65 were due largely to actual decrease in abundance. Figure 4 shows the per-boat catch of albacore and of all tunas and billfishes in long-line fishery from 1948 to 1968. The catch of tunas and billfishes per boat--except in 1952, 1953, and 1954--tended to increase gradually over the years, though fluctuating greatly from year to year. No such tendency was seen in the catch of albacore. Furthermore, the proportion of albacore in total tuna and billfish landings was markedly lower in 1954-65 than in other years (table 1 and fig. 5).

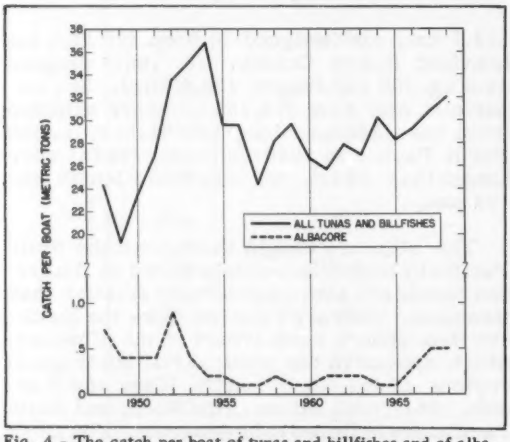

Fig. 4 - The catch per boat of tunas and billfishes and of albacore in the Hawaiian long-line fishery, 1948-68.

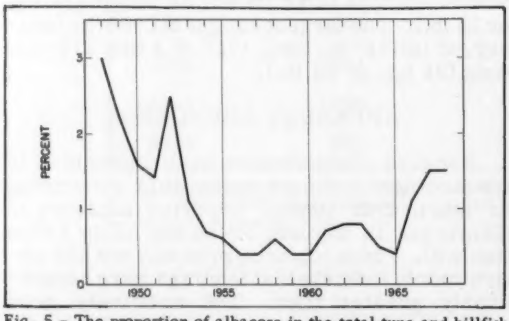

Fig. 5 - The proportion of albacore in the total tuna and billfish landings in the Hawaiian long-line fishery, 1948-68.

SIGNIFICANCE OF HAWAIIAN-CAUGHT ALBACORE

Albacore occur in temperate waters when they are young. They migrate seasonally from eastern Pacific, where they form basis of an American summer fishery, into central western Pacific, where they are basis of Japanese winter long-line fishery. They next appear in the Japanese coastal fishery in the spring; from there, they return once again to winter long-line fishery (fig. 6: Otsu and Uchida, 1963). One hypothesis is that when the fish attain sexual maturity, some adults in Japanese winter long-line fishery move south into subtropical waters during spring; there they form reproductive segment of North Pacific population. It has been postulated further that fish of this reproductive segment appear in Hawaiian fishery. These points are supported by the abrupt increase in albacore catches in Hawaii beginning in June, near the beginning of their spawning period in Hawaiian waters.

Otsu-Uchida Study

In their 1959 study, Otsu and Uchida found no albacore in spawning or near-spawning condition in temperate North Pacific, but they noted that albacore from Hawaii possessed well-developed gonads. The fish from the central equatorial Pacific were in an intermediate stage between the two groups; a few had ovaries in the "late developing" stage. The evidence presented by the Hawaiian albacore pointed to a summer spawning, probably between June and August.

Thus, it appears that the increased landings of albacore in Hawaii beginning in June mark the arrival of fish from the North Pacific Japanese winter long-line grounds. Furthermore, since increased landings correspond in time to spawning period, we may state with some confidence that the Hawaiian

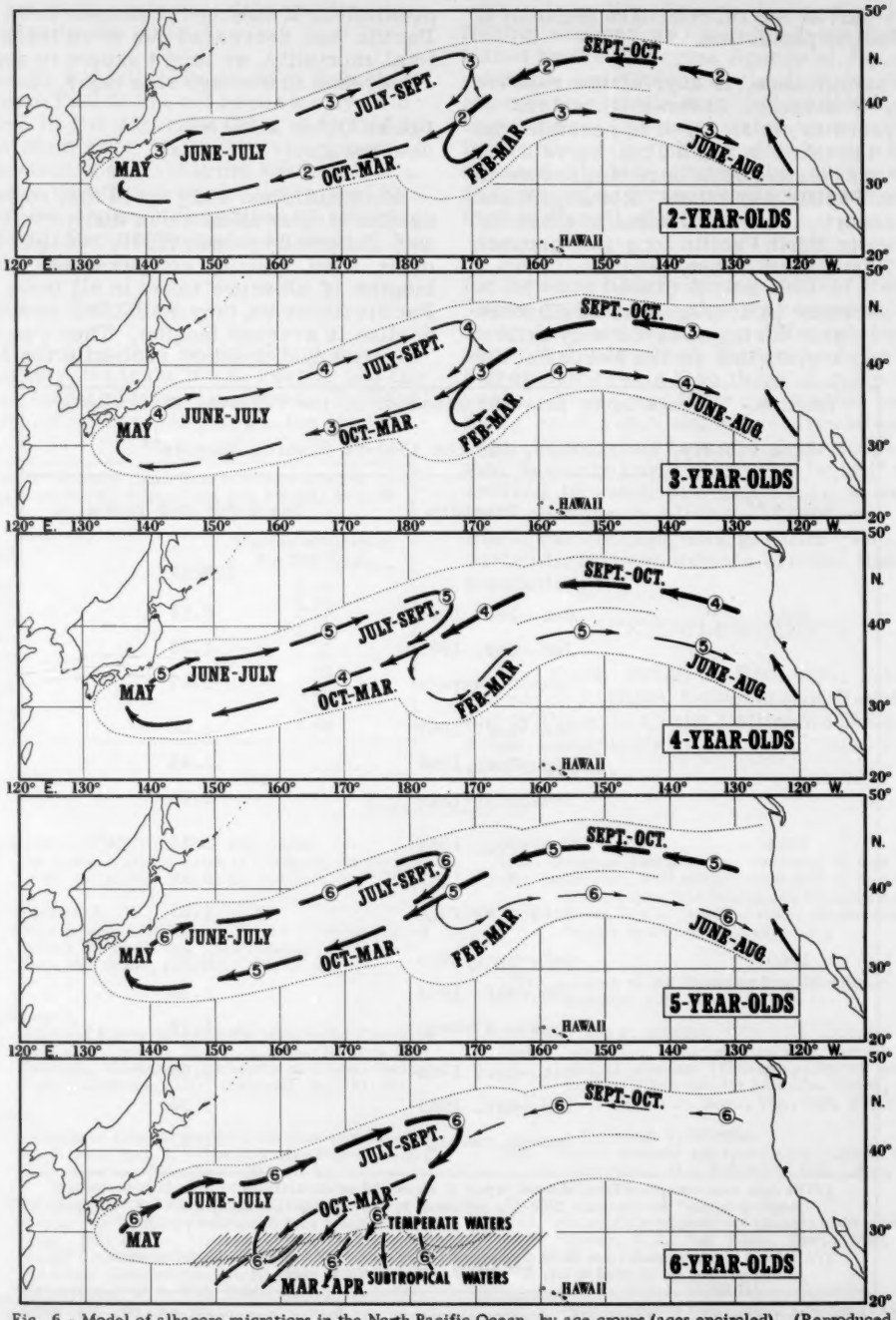

Fig. 6 - Model of albacore migrations in the North Pacific Ocean, by age groups (ages encircled). (Reproduced from fig. 9: Otsu and Uchida, 1963.)

fish are part of the reproductive segment of North Pacific population.

The significance, if any, of the relative scarcity of albacore in Hawaiian waters in recent years is not clear. It is possible that the few fish taken in Hawaii can serve as an index of the relative abundance of albacore in the North Pacific population. Rothschild and Yong* reported a clear decline in albacore abundance in North Pacific long-line grounds during their 1949-61 study period.

The decrease in average size of albacore taken in Hawaii during 1955-68 may reflect further such a decline in the North Pacific population. If albacore abundance in the North Pacific had decreased due to an increase in total mortality, we might expect to see such a decrease in average size (age).

Fewer Older Albacore, Average Lengths Stable

Rothschild and Yong noted that such a reduction of older albacore in the North Pacific was indicated by Suda (1959, 1963b). On the other hand, having computed the average lengths of albacore taken in all three North Pacific fisheries, they could find no apparent decline in average lengths. They concluded: "We cannot, at present, reconcile the decline

Table 4. Average Catch Rates of Albacore in the Japanese Winter Long-line Fishery, by Quarters, for the 1962-66 Fishing Seasons[1/]

Season[2/]	Quarters	Catch Per 100 Hooks
		Numbers
1962	Oct.-Dec. 1962	0.57
	Jan.-Mar. 1963	1.18
	Season average	0.88
1963	Oct.-Dec. 1963	1.06
	Jan.-Mar. 1964	2.43
	Season average	1.66
1964	Oct.-Dec. 1964	0.41
	Jan.-Mar. 1965	1.54
	Season average	1.05
1965	Oct.-Dec. 1965	0.96
	Jan.-Mar. 1966	2.58
	Season average	1.76
1966	Oct.-Dec. 1966	1.09
	Jan.-Mar. 1967	2.54
	Season average	1.97

1/The data were compiled from "Annual report of effort and catch statistics by area in Japanese tuna longline fishery" for the years 1962-67, published by the Research Division, Fisheries Agency of Japan.

2/A fishing season extends from about October of 1 year through March of the following year. The fishing grounds are limited to lat. 20°-40° N., long. 140° E.-180°.

*Rothschild, Brian J. and Marian Y. Y. Yong. MS. Apparent abundance, distribution, and migrations of albacore, Thunnus alalunga, on the North Pacific longline grounds. Bureau of Commercial Fisheries Biological Laboratory, Honolulu, Hawaii 96812.

in one set of the Japanese data and the lack of a decline in the other."

Although a decline in average fish sizes in the North Pacific has not been clearly demonstrated in the Japanese data, reduction in relative abundance of the oldest segment of the population is evident in the Hawaiian data. We believe that this decrease is related to a decline in the apparent abundance of albacore in the North Pacific Ocean as a result of increased total mortality.

Catch Rates Compared

To determine this relationship, the Japanese catch rates in the North Pacific and the Hawaiian landings were compared. Table 4 shows the albacore catch rates in the Japanese winter long-line fishery during the 1962-66 fishing seasons as compiled from data published by the Fisheries Agency of Japan. To maintain consistency in the data, we did not attempt to compile unpublished data for earlier years. The catch rates were generally low, under two fish per 100 hooks, but increased slightly during the 1965 and 1966 seasons; this corresponded to increased landings in Hawaii after 1966.

Table 5 - Average Catch Rate of Albacore in the Japanese North Pacific Winter Long-line Fishery, 1949-57 (from Suda, 1958: Table 2)

Year	Number of Albacore Per 100 Hooks
1949	2.36
1950	2.23
1951	2.86
1952	2.71
1953	1.86
1954	1.55
1955	1.20
1956	2.54
1957	2.82

Suda (1958) published average catch rates for the same fishery during 1949-57 (table 5). These data are not strictly comparable with those in table 4 because different data sets are probably involved. Suda reported slightly higher catch rates than those in more recent years. There was little correlation between these catch rates and annual Hawaiian landings. Despite this lack of correlation, we feel that Hawaiian landings, particularly if standardized in catch-per-unit effort, should reflect changes in albacore abundance in the North Pacific long-line grounds--and, more particularly, in abundance of older fish in the population.

ACKNOWLEDGMENTS

We thank Brian J. Rothchild, Fisheries Research Institute, University of Washington, and William L. Craig, California State Fisheries Laboratory, for their critical reading of this paper.

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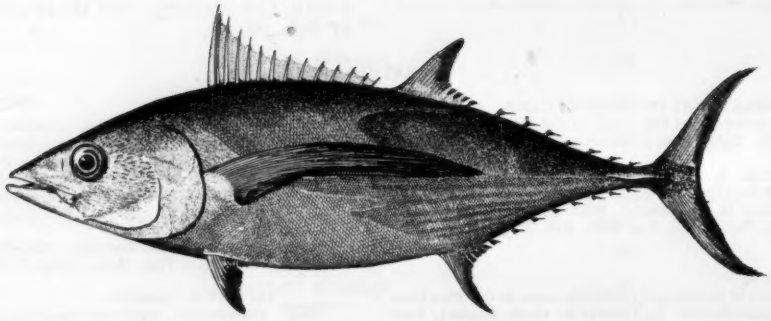

SEASONAL AND GEOGRAPHIC CHARACTERISTICS OF FISHERY RESOURCES

California Current Region--I. Jack Mackerel

David Kramer and Paul E. Smith

This is the first of a series of brief reports in which we intend to describe seasonal and geographic characteristics of the fishery resources in the California Current region. Emphasis will be placed on the use of summarized data to predict when and where adult spawning populations may be found--and whether or not such populations might be available to the fisheries during their spawning cycles. This first report deals with the jack mackerel.

These accounts will introduce a series of existing and future comprehensive reports and analyses in a program of intensive research carried on for more than 20 years by the California Cooperative Oceanic Fisheries Investigations (CalCOFI). The investigations were founded in 1949 to determine the reasons for the decline of the sardine fishery. The chief participants of the CalCOFI are the Scripps Institution of Oceanography (SIO), the California Department of Fish and Game (CF&G), and the Bureau of Commercial Fisheries (BCF). The investigations designated an area for their studies covering approximately 500,000 square miles from the California-Oregon border to the tip of Baja California (fig. 1). Their major task was to study the effects of the biological, physical and chemical environment upon the resources. The role of BCF was to determine the distribution and size of adult fish populations from egg and larva censuses.

In order to determine when and where spawning populations may be found, the data for 10 years, 1951-60, are summarized by grouping ("pooling") stations on the CalCOFI pattern into 40 X 120-mile areas (fig. 2) and observing percentages of occurrences of fish eggs and/or larvae. (Percentages of occurrence are the number of times larvae are found in a sample, divided by the number of samples taken in a particular season and area during the decade.)

In the instance of jack mackerel (fig. 3), the data show that the major centers of spawning (49 percent or greater occurrence of larvae) occur first in March off southern California and northern Baja California; then, as the waters grow warmer, the major centers spread gradually northward as far as San Francisco in July. The absolute range of jack mackerel spawning areas has not been delimited by the CalCOFI. We know from additional surveys by CalCOFI, and other organizations in the United States and Canada, that the jack mackerel populations may extend as far offshore as 800-1,200 miles, as far north as the Gulf of Alaska (Blunt, 1969), and as far south as Cape San Lucas.

The jack mackerel fishery, once only incidental to those of the sardine and Pacific mackerel, suddenly became a major one in 1947--when its total landings were 65,000 tons from a few-thousand-ton fishery in previous years. In the next two decades, 1947-56 and 1957-66, it averaged 40,000 and 35,000 tons per year respectively.

Most landings of jack mackerel are juveniles or young adults taken within 50 miles offshore from San Diego to Point Conception. A small, variable fishery is carried on in Monterey Bay. The Mexican fishery, based in Ensenada, is a moderate one off northern Baja California. The fishery probably uses only a small part of the adult resource, which is estimated to be about 1.4-2.4 million tons within the CalCOFI pattern alone--and approximately twice that amount by adding what is estimated to be in the portion not delimited by the CalCOFI surveys (Ahlstrom, 1968). In

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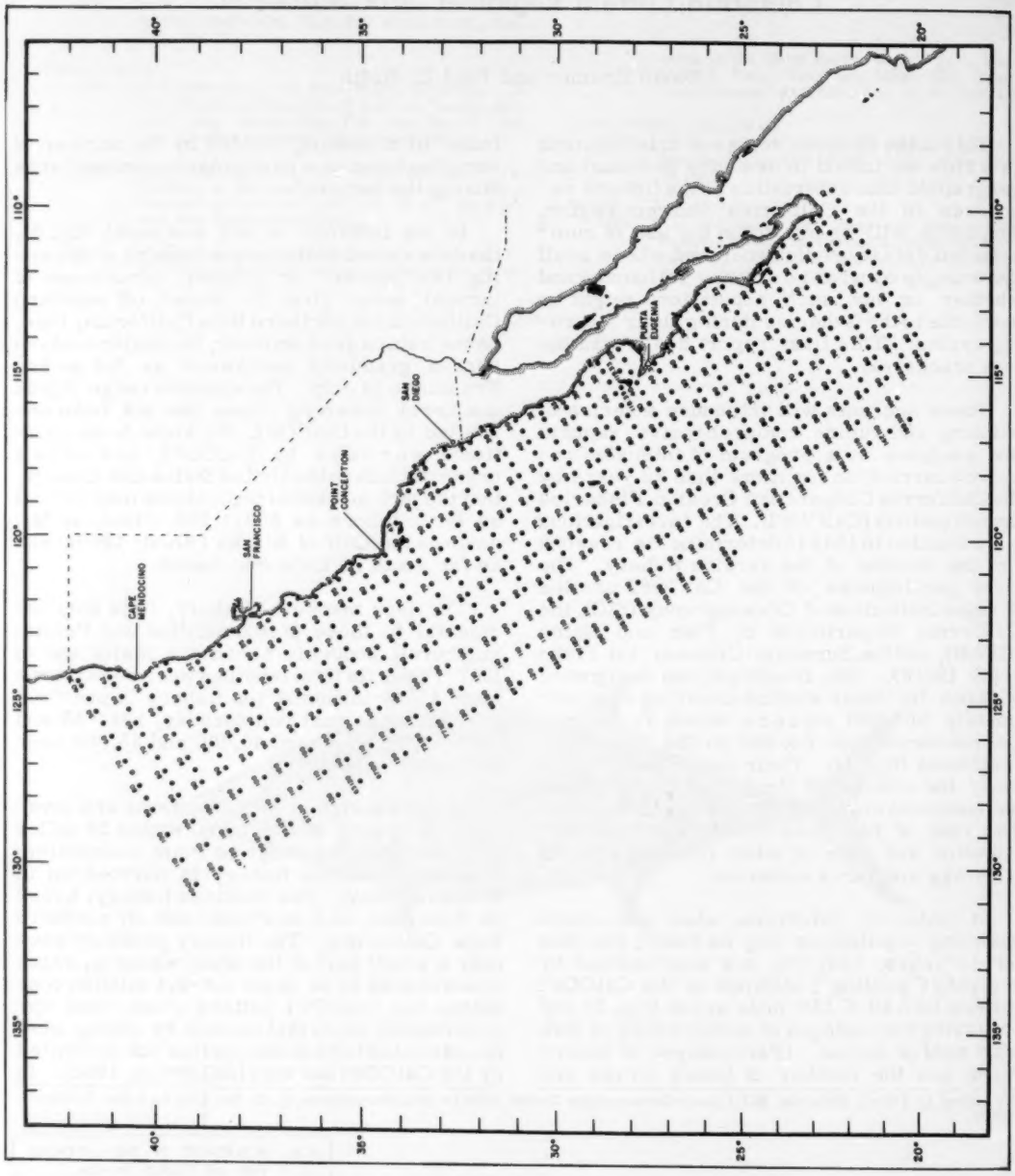

Fig. 1 - Station pattern of the California Cooperative Oceanic Fisheries Investigations (CalCOFI).

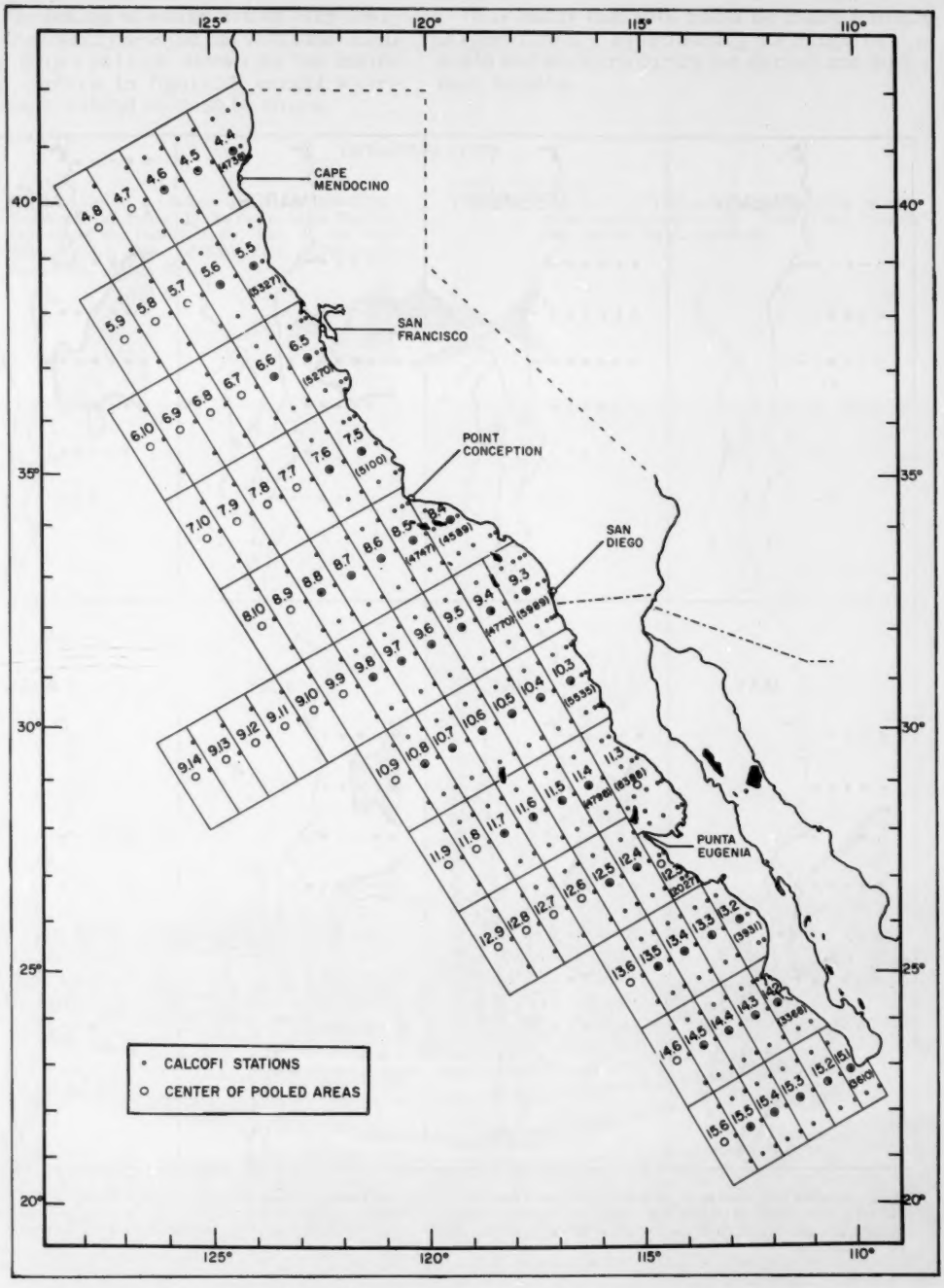

Fig. 2 - Pooled statistical areas of the CalCOFI pattern. Each rectangle represents 4,800 square miles (40 X 120 nautical miles) unless otherwise indicated as in the nearshore delineations.

Fig. 1 - Station pattern of the California Cooperative Oceanic Fisheries Investigations (CalCOFI).

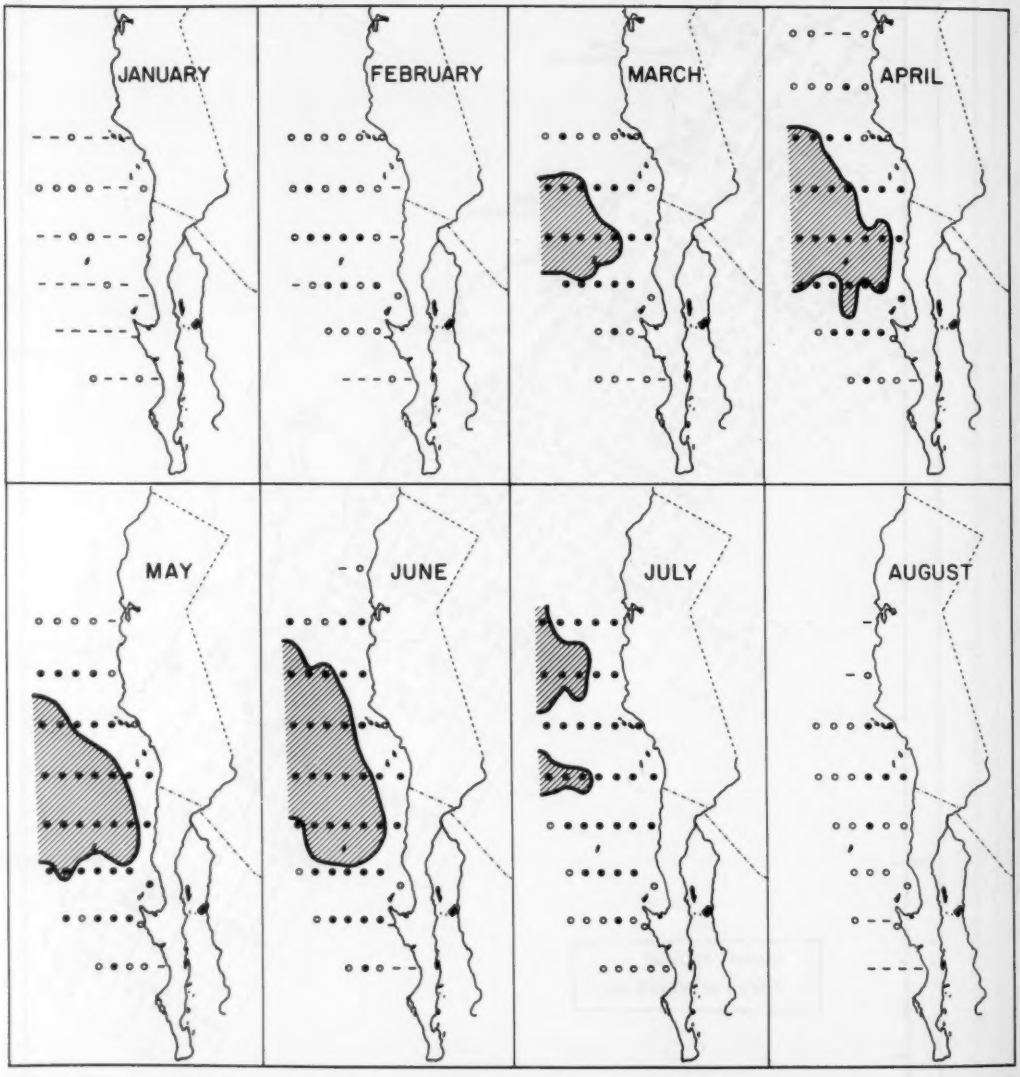

Fig. 3 - Percent occurrences of jack mackerel larvae in 1951-60 on the survey pattern of the California Cooperative Oceanic Fisheries Investigations (CalCOFI). Each line, circle or dot represents a pooled statistical area (see fig. 2). (o) - less than 10% occurrence; (•)- equal to or greater than 10% occurrence; shaded area - greater than 49% occurrence; (-) - area occupied with no occurrences.

addition, the taking of young adults may indicate that the fishery seldom harvests the adult spawning population shown by the major spawning centers in figure 3, except where those centers extend closest to shore.

It is likely that this could be made a much larger fishery by extending its range to the north and seaward during the spring and summer months.

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'North Pacific': 64-ft., San Pedro-stationed jack mackerel purse seiner; 82-ton capacity. (Photo: W. R. Perrin, BCF La Jolla)

BRIT HERRING ALONG MAINE'S COAST

C. W. Davis and J. J. Graham

The Maine sardine industry prefers to can 2-year-old Atlantic herring, Clupea harengus harengus, but when they are not available, 1- and 3-year-old fish are used. To assist the industry in using the herring resource more efficiently, the BCF Biological Laboratory at Boothbay Harbor, Maine, seeks to predict the annual abundance and availability of the 2-year-old fish. As part of this program, herring are studied from the time they hatch in the autumn until the time they may enter the fishery 1 year later.

This preliminary report describes the summer distribution and relative abundance of 1-year-old, or "brit" herring, 2 to 4 inches in length, along the Maine coast in 1966-69.

METHODS AND GEAR

Surveys for brit herring were made twice each summer on inshore and offshore cruise tracks along the Maine coast (fig. 1) with the Department of the Interior vessel 'Rorqual'. The ship's echo-sounder was operated continuously during the surveys, which were made at a vessel speed of about 10 knots. Inshore tracks were covered during daylight, and offshore tracks at night, in 1966 and 1967; both tracks were covered during daylight in 1968 and 1969. Echo-sounder traces were classified as "heavy," "medium," or "light" to denote relative abundance (fig. 2).

A 16-foot semiballoon trawl, fitted with a $\frac{1}{2}$-inch stretch-mesh liner in the cod-end, and a Boothbay Depressor Trawl were used to determine if traces on the echo-sounder were herring. Previous calibration of gear depth to amount of wire out usually enabled us to place the trawls at or near the same depth as the fish traces. Speed of the vessel during towing was approximately 6 knots; duration of the tows was 10 to 30 minutes.

SURVEY RESULTS

Distribution and Abundance

This study and earlier explorations indicate that inshore populations of brit herring remain in the coastal waters throughout the summer. The heaviest concentrations were detected during early summer (late June to mid-July) in the central and eastern coastal areas (figs. 3 and 4). In subsequent cruises (mid-July to late August), the only brit observed were in upper Penobscot Bay, and even there they were scarce. No significant numbers of brit were found along the offshore cruise track in any year.

Brit were noticeably scarce in western Maine compared to central and eastern Maine during these years. No fish were located below Casco Bay.

Sardine Catch Relationship

The persistent occurrence of brit for 3 consecutive years (1966-1968) in central and eastern Maine is reflected in the subsequent total sardine landings. These two areas accounted for over 75% of the annual Maine catch from 1967 to 1969. In western Maine, the brit were very scarce in 1966 but somewhat more abundant in 1967 and 1968. Landings of herring in this region reached a 20-year low in 1967 but increased about 8% in both 1968 and 1969.

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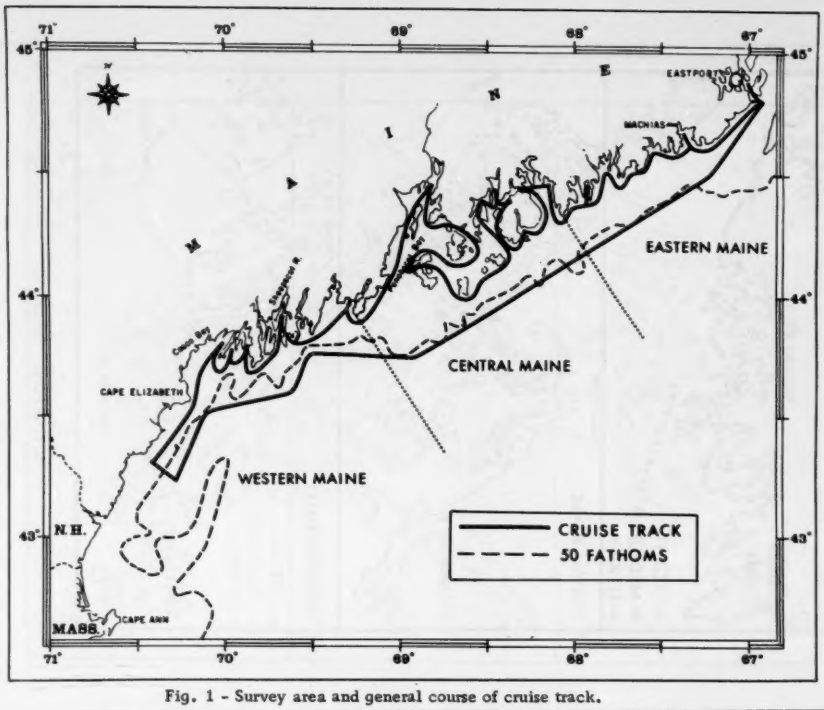

Fig. 1 - Survey area and general course of cruise track.

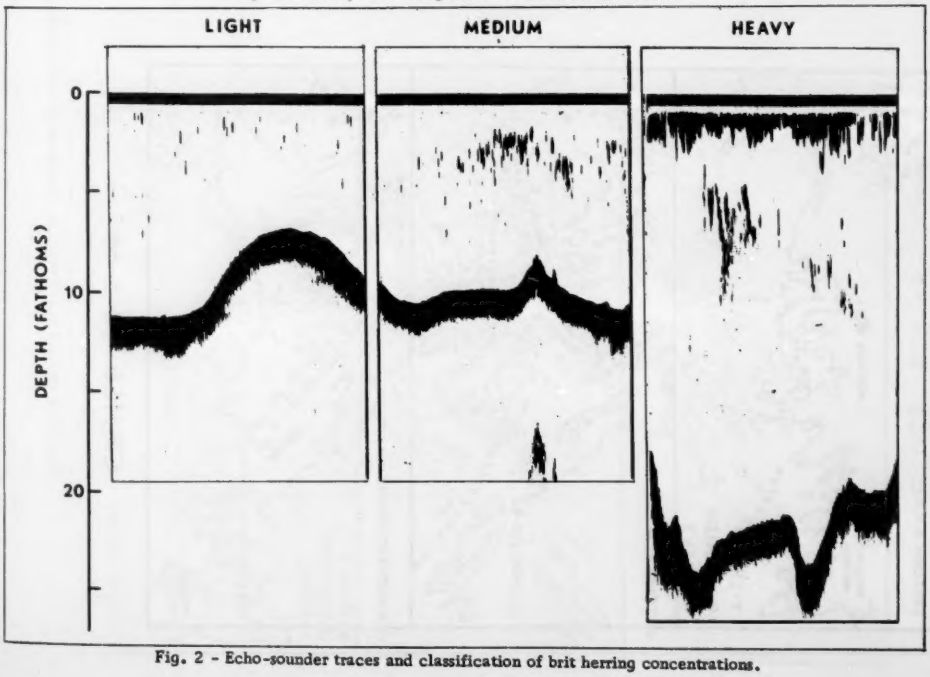

Fig. 2 - Echo-sounder traces and classification of brit herring concentrations.

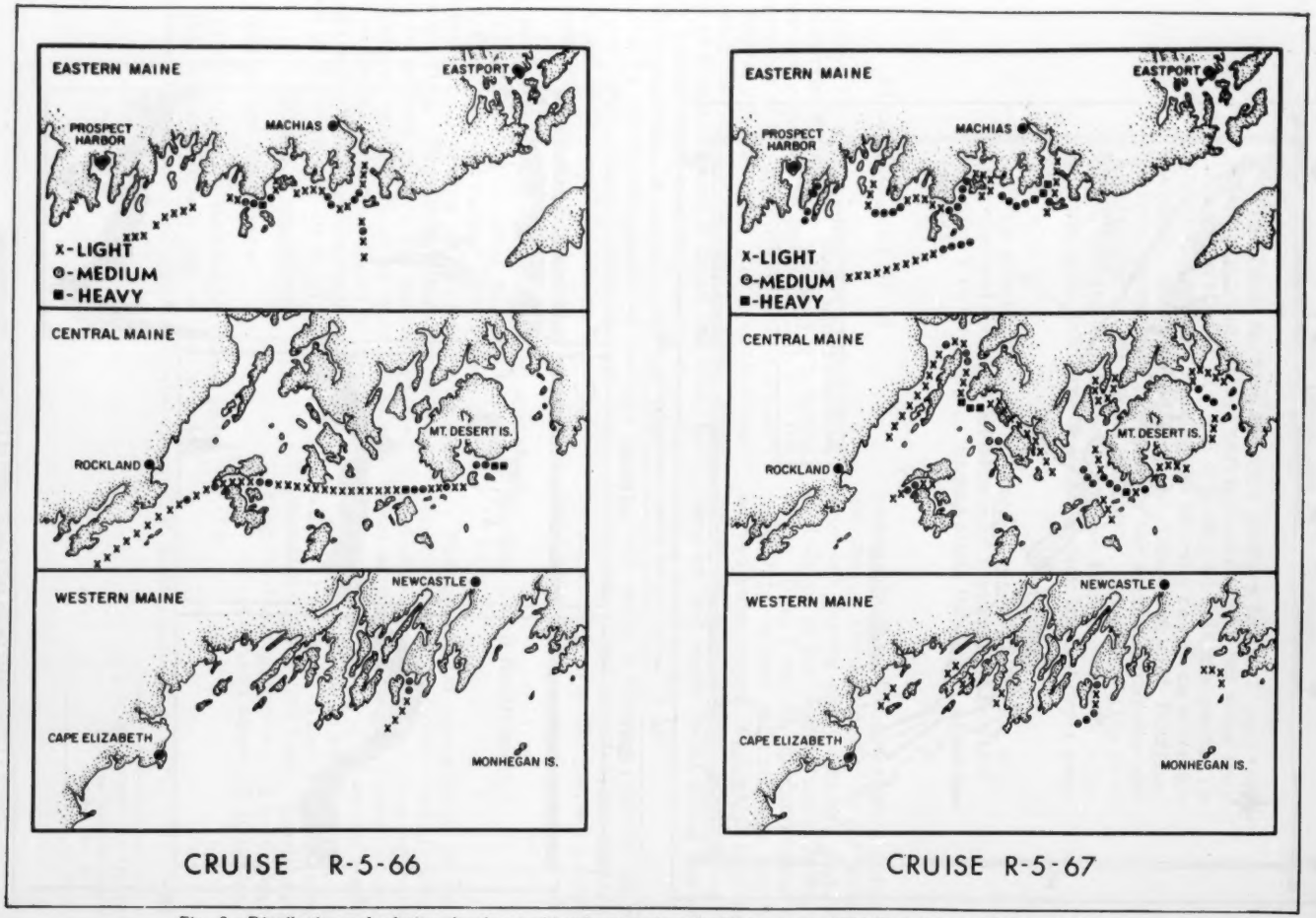

Fig. 3 - Distribution and relative abundance of brit herring along the Maine coast, 1966 (R-5-66) and 1967 (R-5-67).

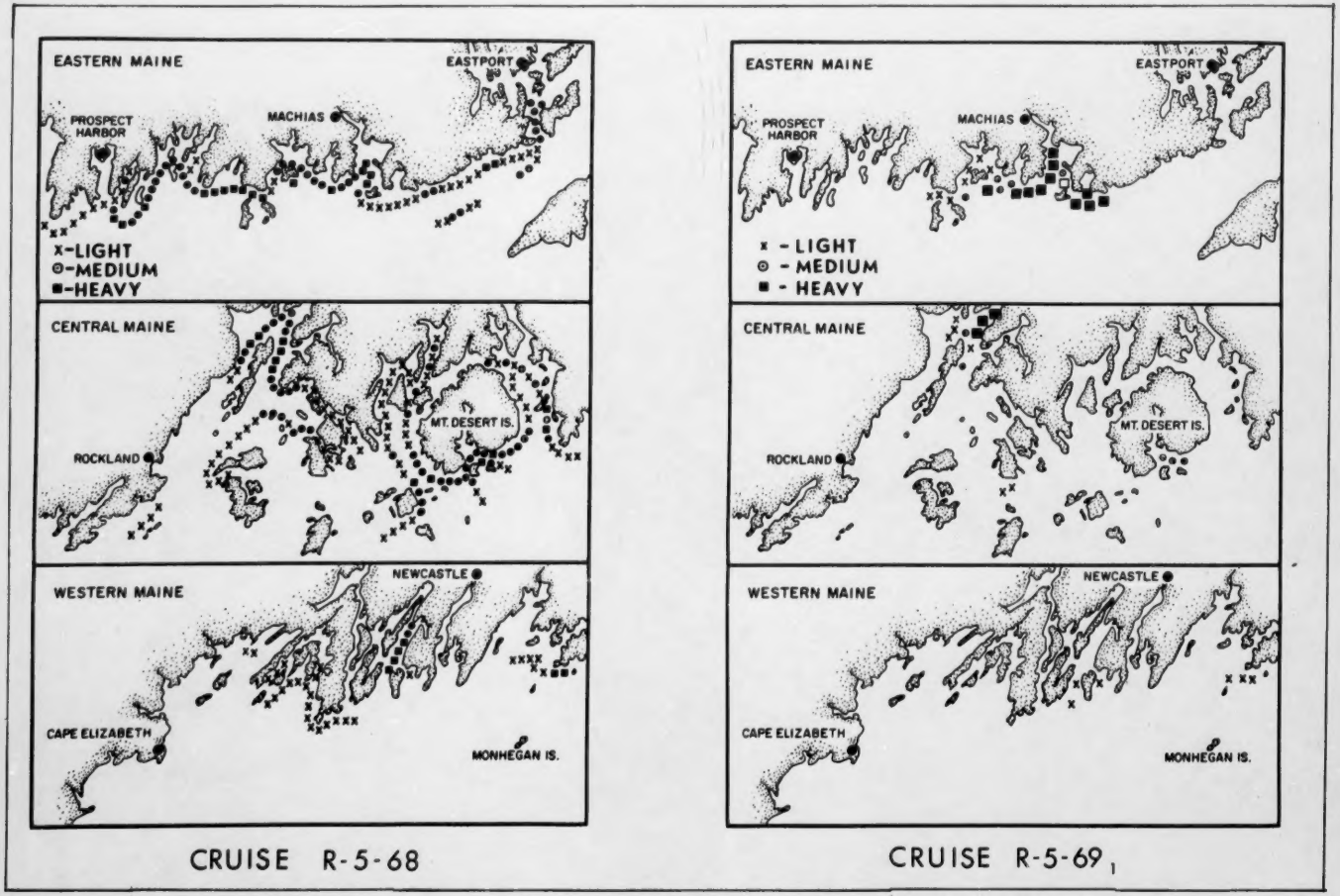

Fig. 4 - Distribution and relative abundance of brit herring along the Maine coast, 1968 (R-5-68) and 1969 (R-5-69).

Fig. 1 - BCF's new bathysphere will transport two observers at atmospheric pressure to a depth of 675 feet. The bathysphere is about 8 feet high and weighs nearly 9,300 pounds (including 2,500 pounds of ballast).

A BATHYSPHERE FOR FISHERY RESEARCH

John R. Pugh and Richard B. Thompson

The Bureau of Commercial Fisheries (BCF) Biological Laboratory in Seattle, Wash., has acquired a bathysphere and a support barge for fishery research. The system will be used in studies to determine the behavior of commercially important marine organisms in their natural environment.

BATHYSPHERE

The bathysphere (fig. 1) was constructed by the Ocean Engineering Division of Reading and Bates of Tulsa, Okla. It is designed to transport two observers at atmospheric pressure to a depth of 675 feet. The sphere is constructed of special steel-plate alloy; the walls are 0.625-inch thick, and the total weight, including the ballast, is about 9,300 pounds. The inside diameter is 5 feet 6 inches. The overall height, including a sturdy-steel framework that supports the bathysphere, is about 8 feet. The bathysphere has two access hatches--one on the side to facilitate entry on deck and horizontal mating with a deck decompression chamber, the other on the bottom to permit divers to exit or enter the pressurized bathysphere at depth. Both hatches have double doors--an external one to withstand sea pressure, and an internal one to withstand interior pressure during lock-out dives. Sixteen portholes (six, 12-inch; ten, 6-inch) provide excellent viewing in all directions. Neoprene bumper pads spaced around the horizontal centerline between the ports help protect the bathysphere during operations at sea. Two fixed quartz iodide lights, each 750 watts, provide illumination for underwater viewing. Electricity for the lights is supplied by surface generators.

Life-support equipment in the bathysphere includes a 48-hour oxygen supply for two observers, and the necessary equipment for removal of carbon dioxide. There is also an auxiliary air supply that can be used: (1) in an emergency, such as failure or contamination of the regular oxygen supply, or (2) for pressurizing the bathysphere at shallow depths (less than 100 feet) for lock-out dives, or (3) by divers with "Hookah" attachments working outside the bathysphere. During dives of long duration, the breathing mixture can be supplied from surface compressors. One instrument allows the observers to monitor the percentage of oxygen in the bathysphere; another allows them to check the carbon dioxide level. A hardwire communications system provides direct contact between the bathysphere and the support barge. One depth gauge allows the observers to monitor their rate of descent or ascent; a second gauge allows them to monitor the pressure in the bathysphere when pressurization is required for lock-out dives.

The bathysphere is about 600 pounds buoyant. Sufficient ballast to make it sink and to stabilize it (about 2,500 pounds) is attached by a $\frac{3}{8}$-inch diameter cable, 100 feet long, to an electrically powered submersible winch fastened to the support frame on the sphere's underside. Under normal operating conditions, the winch cable is wound tight, and the ballast is carried close to the bottom of the sphere. In an emergency, the ballast can be jettisoned, allowing the bathysphere to return to the surface. The bathysphere is also equipped with a release mechanism on the main lifting cable; the occupants can free the sphere from the cable if it becomes fouled.

Flexibility of operation was a major consideration in the bathysphere's design. The submersible winch attached to the support frame is controlled from within the sphere and allows the occupants to position it at various distances above the ocean floor--depending on length of ballast support cable--while remaining independent of the motion of the surface vessel. By directing crane operator to slacken main lifting-cable, and by reversing drive motor on submersible winch, the occupants can leave the ballast on the ocean floor to serve as an anchor. The bathysphere

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will rise toward the surface, allowing the occupants to make observations and a controlled ascent up to the length of the winch cable. Since the winch is electrically powered, the occupants can winch the bathysphere back to the bottom if they desire.

SUPPORT BARGE

In Puget Sound, the bathysphere is transported and supported by a self-propelled barge (fig. 2), which is 104 feet long, 31 feet wide, and displaces 240 gross tons. (However, the sphere can be supported by any vessel that has adequate deck space and is capable of lifting about 5 tons.) The barge is equipped with a diesel-powered, friction-driven crane that has a 15-ton lifting capacity. The crane drum holds about 1,200 feet of nonrotating $\frac{7}{8}$-inch cable with a rated breaking strength of 32,000 pounds. About 1,100 square feet of uncluttered deck space forward of the crane provides ample room to stow or support the bathysphere.

The barge requires a minimum crew of three--a helmsman, an operating engineer, and a deckhand. During diving operations, when the barge is securely moored, the engineer operates the crane and the helmsman and deckhand tend the bathysphere. Usually, two or more biologists serve as observers in the bathysphere and assist the barge crew wherever needed during station changes and mooring operations.

PRELIMINARY TESTS

In June 1969, the bathysphere, unmanned, was successfully tested to a depth of 1,500 feet. The BCF research vessel 'Miller Freeman' (fig. 3) transported the sphere to Jervis Inlet, about 60 miles north of Vancouver, B.C., the only nearby site in protected waters with suitable depth. The bathysphere was lowered and raised with the conventional trawling winches, cable, and gantry permanently installed aboard the vessel.

The purposes of the tests were: the final acceptance trial under the terms of the contract; to demonstrate the bathysphere's structural integrity, and to show its ability to withstand pressures at depths far greater than those at which it will be used in fish behavior research.

The first manned dives were conducted at the BCF research station at Manchester, Wash., on Puget Sound, from September 30 to

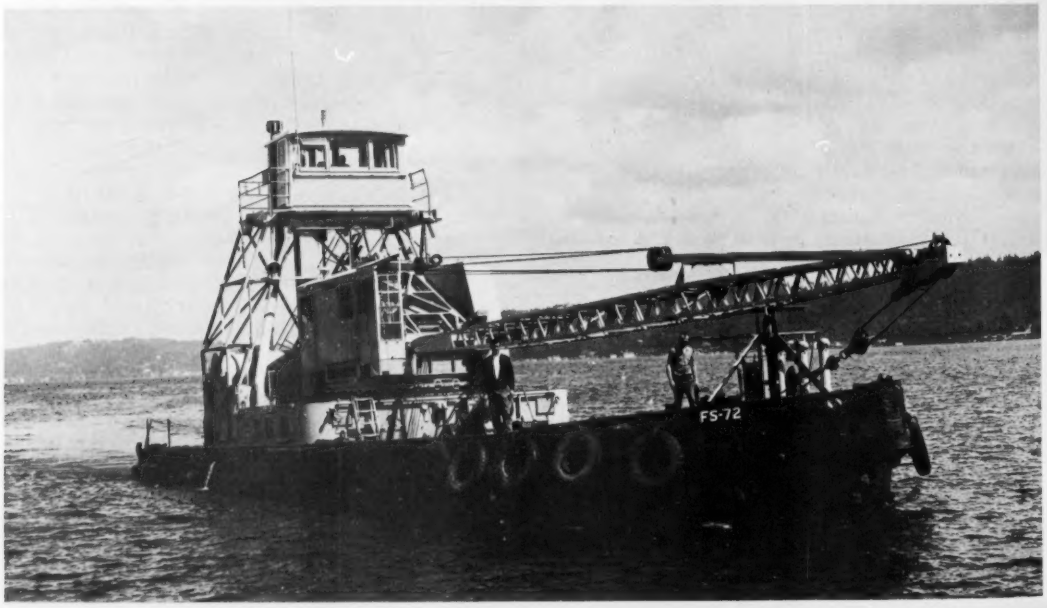


Fig. 2 - The bathysphere's self-propelled support barge, a converted airplane salvage barge, 104 feet long, has a cruising speed of about 8 knots; it carries two scientists and a crew of three. The crane on the barge is capable of lifting 15 tons.

Fig. 3 - The bathysphere can be lowered and raised with the trawling winches, cables, and gantry that are permanently installed aboard the 215-foot Miller Freeman, the Seattle Biological Laboratory's research vessel.

October 8, 1969. The various safety devices and life-support systems of the bathysphere were tested. All systems functioned according to design.

There were additional tests to determine the ability of observers to recognize objects of unknown size and to estimate the distance of various objects from the bathysphere. The results showed that each of four observers tended to underestimate both the size and the distance of objects from the bathysphere.

Another test at Manchester was designed to determine underwater viewing capability from the bathysphere. It showed that the cone of vision through the view ports decreased from about 120° when the bathysphere was above the surface to about 90° underwater. An example of the underwater view through one of the 12-inch ports is shown in figure 4. There was variation caused by the diameter of the viewports; also, the cone of vision varies according to the porthole used because the arrangement of instruments restricts observer's ability to place his eyes close to the inside surface of some portholes. Since the portholes tested were in favorable locations, a 90° cone of vision probably is the maximum attainable viewing capability. The 16 viewports spaced around the bathysphere provide a good view in all directions.

Fig. 4 - Sea anemones (Metridium) attached to concrete blocks as observed at a depth of 40 feet from one of bathysphere's 12-inch viewports.

APPLICATION

The bathysphere has the flexibility to permit "lock-out" dives; trained SCUBA divers can exit from the pressurized sphere through the lower hatch to perform work outside (fig. 5). Captured fish may be examined, tagged, and released at depth by divers; this capability will eliminate the damaging effects of pressure changes that can occur when fish are brought to the surface for tagging. Species studied will probably be shellfish (scallops), rockfishes (Pacific ocean perch), and flatfishes (soles, flounders). The initial use of the bathysphere, however, will be as a personnel-transfer capsule in the TEKTITE II program. The Department of the Interior is responsible for implementing and managing program now underway in the U.S. Virgin Islands.

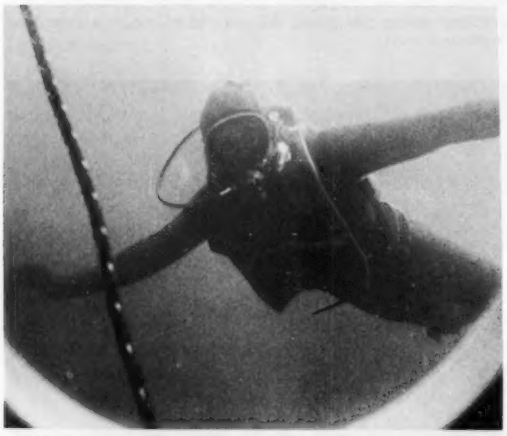
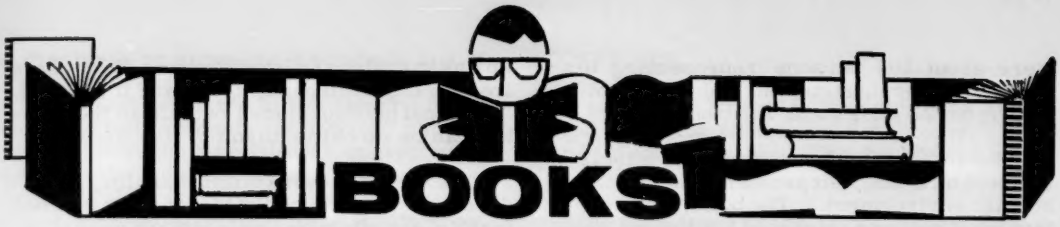


Fig. 5 - Trained SCUBA divers can emerge from the pressurized bell through the lower hatch to perform work outside.

Fig. 6 - The weathervane scallop ('Patinopecten caurinus') will be the object of study in one of the bathysphere's first applications. Scientists hope observations on scallop behavior will explain inconsistency of commercial catches.

As one of the first practical applications for the bathysphere locally, we propose to study the natural behavior of weathervane scallops, Patinopecten caurinus (fig. 6) on commercial dredging grounds near Bellingham, Wash. On the basis of reports from commercial scallop fishermen, we believe the species may be exhibiting some natural evasive reaction to scallop dredges. A difference between their day and night behavior is also suspected. Perhaps these responses can be observed from the bathysphere. We will look for natural behavior patterns--such as burrowing, prolonged or erratic swimming, mass migrations, and reactions to changes in light intensity, tidal flow, turbidity, and temperature--which might help explain the inconsistency of scallop catches. Future observations on rockfish and flatfish may take the bathysphere onto the Continental Shelf.



DISEASES

"Principal Diseases of Marine Fish and Shellfish," by Dr. Carl J. Sindermann. Academic Press of New York and London.

The book "represents the first attempt ever to summarize information about diseases of marine fish and shellfish." It "first reviews the principal diseases of marine organisms, then examines disease-caused mortalities, disease problems in mariculture, internal defense mechanisms, and the relation of human diseases to those of marine animals. It also assesses the impact of disease on marine populations."

The book will be useful particularly to persons involved in oceanography, marine biology, and aquaculture. Because Dr. Sindermann's style is "straightforward and his language not unduly scientific," the book will interest both layman and scientist.

Dr. Sindermann is director of BCF Tropical Atlantic Biological Laboratory (TABL), Miami, Fla.

POLLUTION

"Effects of Abatement of Domestic Sewage Pollution on the Benthos, Volumes of Zooplankton, and the Fouling Organisms of Biscayne Bay, Florida," by Dr. J. Kneeland McNulty. University of Miami Press, Drawer 9088, Coral Gables, Florida 33124. 128 pp., clothbound, $6.95.

A study of the effects of pollution on marine life. "Such studies are rare because the onset of pollution is generally gradual, and, by the time that the need for a study is recognized, it is too late to obtain data on earlier, unpolluted conditions." The study "is especially important because the fauna and flora of Biscayne Bay are tropical, and very little is known of the effects of pollution in the tropics."

Florida's Biscayne Bay offered the opportunity of comparing polluted conditions with the situation some years after a sewage treatment plant was installed. Various elements of the biota of northern Biscayne Bay were studied before and after abatement of pollution. The pollution consisted of 136 to 227 million liters per day of untreated domestic sewage.

Four years after removal of pollution, some changes had taken place.

Dr. McNulty states: "At distances of 100 to 740 meters seaward from outfalls, in water depths of one to three meters in hard bottom, populations of benthic macroinvertebrates had declined from abnormally large numbers of species and individuals to normal numbers of each, while soft-bottom populations had changed qualitatively but not quantitatively. Adjacent to outfalls, populations had increased in numbers of species and numbers of individuals in hard sandy bottoms only. Volumes of zooplankton had decreased to about one-half the pre-abatement values in poorly flushed waters; elsewhere, they remained about the same. Dissolved inorganic phosphate-phosphorus decreased similarly. Abundance of amphipod tubes had declined markedly, a change not shared by quantities of other fouling organisms (including barnacles), which remained about the same. There was no evidence of improved commercial and sport fishing following abatement; this is interpreted to mean that long-lasting detrimental effects have resulted from pollution and dredging."

THERMAL WORKSHOP

Proceedings of the 2nd Thermal Workshop, U.S. International Biological Program, 'Chesapeake Science', Sept. & Dec. 1969. The workshop was sponsored by the National Academy of Sciences and held at the University of Maryland Nov. 3-7, 1968. Attending

were about 200 persons representing University, Federal, state, and industrial interests from 27 states and 6 nations.

The conference focused on "the effects of temperature and temperature change in the aquatic environment." The biological role of temperature was stressed, although some physical and chemical aspects were covered.

It was divided into 4 sessions: 1) presentations concerning role of temperature--in basic and applied sense--on plant and animal populations; 2) results of cooperative study on ecological effects of thermal discharge from a steam electric station upon the Patuxent Estuary; 3) demonstrations of field and laboratory equipment and methods used in the Patuxent Estuary studies; 4) discussions of research design, methodology, equipment in such areas as primary production, invertebrates, vertebrates, management, and respiration.

THE FOLLOWING PUBLICATIONS OF THE DEPARTMENT OF INTERIOR, FISH & WILDLIFE SERVICE, ARE AVAILABLE FROM DIVISION OF PUBLICATIONS, BCF, 1801 N. MOORE ST., ARLINGTON, VIRGINIA 22209:

FISH HANDLING

"Recommended Practices For Vessel Sanitation And Fish Handling," by Edgar W. Bowman and Alfred Larsen, Circ. 333, March 1970, pp. 1-27, illus.

Fish-handling practices aboard commercial fishing vessels have evolved "largely through trial and error"--and not through adoption of research findings. Fishermen "have not always kept pace" with public's increasing demands for higher-quality fishery products. This booklet provides industry with a measuring rod to evaluate itself. Also, it recommends ways to improve vessel sanitation and fish-handling techniques.

The gear and techniques of modern fishing have facilitated larger catches in shorter time. The technology of processing and fish use gives the public more new products: from "traditional dried and salted fish to the ultra-convenient boil-in-the-pouch items." Despite sophisticated processing, however, there is no way to restore fish quality once it has been lost through mishandling aboard the vessel. "The final product placed on sale in the market can be no better than the fish itself."

The booklet covers: fish-handling procedures, refrigeration of fresh fish, holding fresh fish, effective and constant sanitation, personnel sanitation practices, present and future vessel design.

SALMON

"Effect of Flow on Performance and Behavior of Chinook Salmon in Fishways," by Clark S. Thompson, SSR--Fish. No. 601, March 1970, 11 pp., illus.

The author studied adult fall-run chinook salmon (Oncorhynchus tshawytscha) during "plunging and streaming conditions of flow in a pool-and-overfall fishway that permitted recycling of fish after each completed circuit." The flows were controlled by adjusting valves in a lock at head of fishway. Individual fish were timed as they ascended a certain number of pools under each condition.

The data suggest that "plunging and streaming flows may be equally suitable for the passage of chinook salmon in a pool-and-overall fishway." About 60% of fish "ascended slightly faster in the streaming flow"; the average ascent rate for all fish was "slightly higher in a plunging flow."

Mr. Thompson describes orientation of fish to type and velocity of flow. He states: "Most fish preferred to rest in the lower downstream quadrant of the pool in a plunging flow; conversely, the lower upstream quadrant was preferred in a streaming flow. Resting fish always faced the current."

"Birectilinear Recruitment Curves to Assess Influence of Lake Size on Survival of Sockeye Salmon (Oncorhynchus nerka) to Bristol Bay and Forecast Runs," by Ralph P. Silliman, SSR--Fish. No. 600, March 1970, 9 pp.

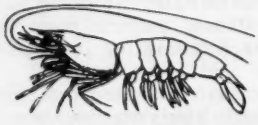
"Comparison of the sizes of lakes and the sizes of sockeye salmon runs to Bristol Bay shows that the two variables are closely related. Birectilinear reproduction curves express quantitatively the dependence of

small returns on escapement numbers and of large returns on lake capacity. Comparison of 'hindcasts' from the birectilinear curves with published forecasts for 1961-67 showed that those from the birectilinear curves were closest to the actual returns. This situation changed in 1968-69. A composite of birectilinear return estimates and 'probability tree' age allocations is worth considering."

SHRIMP

"Western Atlantic Shrimps of the Genus Penaeus," by Isabel Perez Farfante, Fishery Bulletin, Vol. 67, No. 3, June 1969, pp. 461-591.

"Four subgenera of the genus Penaeus are described (Litopenaeus, Penaeus s.s., Fenneropenaeus, and Melicertus). Eight species and subspecies (P. setiferus, P. schmitti, P. duorarum duorarum, P. duorarum, notialis, P. aztecus aztecus, P. aztecus subtilis, P. paulensis, and P. brasiliensis) are recognized as occurring in the western Atlantic. Synonymies are given. Lectotypes have been designated for two species, and the disposition of all types is shown. Diagnoses, detailed descriptions, and illustrations are presented for each species and subspecies. Geographic and bathymetric distributions are given. Affinities are discussed, and conclusions concerning ranges of variation and their spatial distribution are based on morphometric studies and other characters. The development of the external genitalia through the juvenile stage and the size range at which each taxon reaches the subadult stage are presented. Many details of ecology and life history are critically summarized and reviewed. A brief appraisal of the commercial importance of each form is also given."



ROCKFISHES

"Fecundity, Multiple Spawning, and Description of the Gonads in Sebastodes," by John S. MacGregor, SSR-Fish. No. 596, 12 pp., Mar. 1970.

"The rockfishes of the genus 'Sebastodes' (family Scorpaenidae) support an important commercial and sport fishery along the coast of California, where more than 50 species occur.... These fishes are of special biological interest because they are ovoviviparous [producing eggs that have a well-developed shell as in oviparous animals, but which hatch within parent's body, as in many reptiles and elasmobranch fishes]. Together with 18 species of viviparous Embiotocidae they contribute to a marine fauna that probably contains a higher proportion of species of live-bearing fishes than that in any other similar area in the world.

"Estimating the seasonal fecundity of a fish species presents two primary problems. The first and easier problem is to determine the numbers and size distribution of yolked eggs in the ovary. The second and more difficult is to determine how many times the fish spawns during the spawning season."

"In the ovaries of nine species examined, evidence of two spawnings per spawning season was found in three (S. ovalis, S. constellatus, S. paucispinis) but not in the other six (S. carnatus, S. rosaceus, S. serriceps, S. serranoides, S. atrovirens, S. ruberrimus). Two spawnings were indicated by either (1) small numbers of advanced larvae entrapped in the ovaries and associated with full complements of developing eggs or early embryos or (2) a secondary group of developing eggs along with about equal numbers of advanced embryos. The relative number of eggs or embryos was lower in the three species that gave evidence of two spawnings (162 eggs or embryos per gram of fish) than in the other six species (280 eggs or embryos per gram of fish)."

INTERNATIONAL

FAO AIDS ARGENTINE FISHING INDUSTRY

An FAO/UNDP fishery research vessel, the 'Cruz Del Sur' (Southern Cross), is helping to improve fish production in a land where beef is king: Argentina. The 107-foot, Norwegian-built, steel-hulled vessel belongs to an FAO development project.

The 5-year, $3,133,350 project, financed jointly by Argentina and the UN Development Program, seeks to develop the fishing industry, including marketing and distribution. It aims at a better, more varied, diet for Argentinians--and at building fishery exports and reducing imports through resources survey and exploratory and experimental fishing.

Fish Consumption Low

In 1968, Argentinians consumed an average of only 2.7 kilograms of fish, compared with 83.5 kilograms of beef and varying amounts of other meat products. (A kilogram is 2.2 pounds.) Fish consumption in greater Buenos Aires was almost 5 kilograms per inhabitant; in Corrientes and elsewhere, it was as low as 50 grams. Fishery imports increased from 1,438 tons in 1964 to 3,095 tons in 1968.

Vessel's Mission

The Cruz Del Sur was designed and built to FAO specifications for experimental trawling and purse seining. "Her mission: to conduct exploratory surveys and scientific research in demersal (bottom) and pelagic (open water) species--such as bonito, mackerel and hake--along Argentina's 4,100-kilometer coast."

She was launched in 1968. By 1969, she had set high standards of performance for her class. In 11 months, she sailed 45,000 miles, logged 220 days at sea, and sold her total catch for almost $40,000 in Mar del Plata. The money was put back into the project to buy fishing gear and other equipment.

Finds Fish

"Even more important, the vessel identified large stocks of anchovy, hake, bonito, mackerel, and other commercially valuable fish." She reported her findings to local fishermen. The vessel is studying and evaluating fishery stocks and helping to locate new and more profitable fishing grounds.

She is introducing new fishing techniques and gear for pelagic and demersal fishing. The FAO project has helped local fishermen catch enough bonito to reduce substantially bonito imports. Studies aim at improving marketing and distribution facilities for fresh and processed fish. Housewives have been polled to determine their preferences for fish foods.

Project manager is A.E. Fernandez y Fernandez of Spain, who heads a multinational staff of master fishermen, technologists, biologists, and economists.

FAO Fleet

The Cruz Del Sur will be joined by another research vessel provided by Argentina. There are more than 30 FAO/UNDP fishery research vessels--large stern trawlers-purse seiners to fresh water catamarans--which operate in Latin America, Africa, and Asia.

Two sisterships of the Cruz Del Sur are attached to projects in Colombia and Peru.

SCANDINAVIANS REJECT BRITISH SALMON-BAN PROPOSAL

Fishery associations in Norway, Sweden, and Denmark have rejected a British proposal for a total ban on salmon fishing in North Atlantic international waters, reports the Danish Fisheries Association (vessel owners).

The associations stated that the proposal lacked scientific basis and countered the principle of using the seas' riches.

The associations were willing to discuss arrangements to avoid excessive expansion of the international salmon fishery. (Reg. Fisheries Attaché, U.S. Embassy, Copenhagen, Mar. 24.)

FISHERY EDUCATION & TRAINING VITAL TO DEVELOPING NATIONS

"Fishery development requires urgent action to promote education and training in developing countries," an FAO conference concluded on April 16. This is particularly true for those fishermen who live off their catch. And they comprise 80% of the world's fishermen.

This was one recommendation of the 34-nation FAO Committee on Fisheries after a six-day review of world fishery problems in Rome. Observers from 23 member states and the USSR and representatives of a dozen international groups attended. Klaus Sunnanaa, Norway's Director of Fisheries, was chairman.

Educational Tools Needed

The need to train fishermen in developing countries in new industrial techniques was highlighted. The Committee agreed that the plight of subsistence fishermen, who literally live on what they catch, must be recognized. Speakers emphasized the need for simple teaching manuals, more training and use of extension workers, and manpower surveys.

Subsistence Fishermen

This need is "a great human problem," said A.W.H. Needler, Canada's Deputy Minister for Fisheries and Forestry. Subsistence fishermen account for half his country's fish catch, noted Domingo D. Tapiador, Deputy Commissioner for Fisheries of the Philippines. Any improvement in their lot would mean more production. He emphasized the need for better marketing and distribution facilities. He recommended joint ventures between government and private industry to promote fisheries.

Tapiador's points were supported by Stephen A. Tolbert, president of Mesurado Group of Companies Ltd., Monrovia, Liberia, in his keynote address. He urged combined efforts by government, industry, and private institutions to help developing countries establish and operate modern fishing industries.

Studies Needed

The Committee also urged continued work by FAO's Department of Fisheries in development and management of fishery resources, including stock assessment.

NORDIC FISH-MEAL FACTORYSHIP OPERATES OFF AFRICA

A Swedish-Norwegian firm has started fishing off West and South Africa with the mothership 'Astra' and 11 Norwegian purse seiners. The Swedish medical-supply firm Astra A/S and Thor Dahl's whaling concern of Sandefjord, Norway, are the principal operators.

Whaling Firm Involved

Sandefjord has reconstructed the 19,168-GRT whaling ship 'Thorshavet' into a floating fish-meal factory. The firm is registered in Bermuda as Astra Overseas Fishing Ltd. It has made Las Palmas, Canary Islands, its home port for the expedition.

The vessel is designed to produce fish meal from fresh fish especially for fish protein concentrate (FPC). The Astra's move into FPC field requires that it insure sufficient supplies of high-grade raw materials.

The Crew

The crew aboard the purse seiners are Norwegians. They are paid a monthly salary of US$285--plus a bonus of two kroners (28 US¢) a ton on delivered catch. Their 9-month contract will be in force through 1970.

The Catch

The catch, mostly pilchards, is expected to reach 200,000 metric tons of raw material. This would produce about 25,000 tons of concentrate.

The fleet sailed from Norway in late March 1970 for a rendezvous in Las Palmas. The seiners had been fitted out in Norway with netting costing $428,000.

Bad Year for Norwegians

The large Norwegian purse-seine fleet has had problems in the past year. Herring and mackerel were scarce in the Norwegian Sea and in the North Sea. International regulations of these waters are under consideration. The only chance today for profitable fishing is for capelin off North Norway's coast. However, the present fleet is too large and seeks new fishing areas. ('Fiskaren,' Mar. 12.)

JAPAN-USSR 1967-69 SALMON CATCHES REPORTED

On March 2, 1970, the Japanese Fisheries Agency released data on the 1967-69 salmon catches of Japan and the USSR, then meeting in Moscow to set 1970 quota. ('Suisan Tsushin', Mar. 4.)

Japan-USSR Salmon Catches, 1967-69

Salmon Species	Japan 1967	Japan 1968	Japan 1969	USSR 1967	USSR 1968	USSR 1969
	(Metric Tons)					
Red	20,493	16,766	15,502	3,018	2,249	1,640
Chum	51,630	42,519	30,171	20,639	13,697	5,867
Pink	64,481	42,787	69,520	50,701	16,253	63,436
Others	4,904	7,039	11,127	4,523	3,992	4,525
Total	141,508	109,111	126,320	78,881	36,191	75,468

ECUADOR SEIZES 2 JAPANESE FISHING VESSELS

Since the beginning of 1970, two Japanese fishing vessels (presumably tuna longliners) were seized by Ecuador: 'Seiyu Maru No. 12' (403 gross tons), on Feb. 19 near 0.5° S. latitude and 94° W. longitude off Galapagos Islands; and 'Sanyo Maru No. 38' (494 gross tons), an Okinawan vessel, on Feb. 25.

All crew members of the Seiyu Maru were reported released on Mar. 2. ('Katsuo-maguro Tsushin,' Mar. 5.)

JAPANESE PLAN JOINT SHRIMP OPERATIONS

The Hokuyo Suisan Fishing Co. was planning joint shrimp-fishing ventures with Sierra Leone and Gambia around April 1970. In Sierra Leone, where there is no shrimp fishery, the operation will be set up at Freetown. The Japanese will put up 60% of capital; Sierra Leone 40%.

In Gambia, Bathurst will be the site. Investment will be 50-50.

Gambia Favors Hokuyo Suisan

In Gambia, U.S., British, French, and Spanish fishery firms also are seeking shrimp-fishing licenses. Reportedly, Gambia intends to grant permission first to Hokuyo Suisan. That firm plans to use two 100-gross-ton vessels to serve both ventures. ('Shin Suisan Shimbun,' Mar. 2.)

SAVE 'CLEAN' WATERS OF AFRICA, FAO URGES

Action to protect the "clean" waters of Africa and other areas from pollution was urged by FAO's 34-nation Committee on Fisheries meeting in Rome in April.

E. S. Kanyike, Uganda Fisheries Department, said pollution in Africa was less serious than in Europe, but action should start immediately to meet the threat. He warned that agricultural development in his own country had increased the problem of water and fish contamination from insecticides.

"We send out pamphlets urging people to eat more fish. Perhaps we are saying to them to eat more DDT," he remarked.

Domingo D. Tapiador of the Philippines endorsed the FAO proposal. He said 12 factories in his country had been closed because of their discharges, and lawsuits were pending over pollution. Fish culture is especially vulnerable to pollution, he warned.

Philip M. Roedel, Director of the Bureau of Commercial Fisheries, U.S. Department of the Interior, said the U.S. was very aware of the "urgent need" to safeguard the quality of the environment. He urged FAO to study the inland waters of Africa which may be threatened by pollution. He strongly endorsed FAO plans to hold a conference in December 1970 on the effects of marine pollution on fisheries and other living resources.

Cedric G. Setter, Assistant Secretary of Australia's Fisheries Division, said pollution was beginning to threaten the famed Great Barrier Reef. One major oil spill already had taken place. His government was studying the whole subject. He urged a study and evaluation of detergents used in combating oil spills on the sea.

CANADA

EARMARKS PRICE STABILIZATION FUNDS FOR LAKE ERIE PERCH

C$1 million has been earmarked for a price-stabilization program for Lake Erie perch in 1970-71. It will be made available to the Fisheries Prices Support Board to ensure minimum prices to fishermen during peak periods. This was reported by Dept. of Fisheries and Forestry on March 16.

Under the program, the Board will purchase frozen perch fillets from processors--provided fishermen have been paid a minimum of 10 cents per pound for spring perch (April 1 to May 31) and 12 cents a pound for fall perch (June 1 to March 31). These prices are based on whole fish packed and delivered to processing plants.

Much Like 1969 Program

The program is similar to 1969 program except there will be no blending of spring price. Last year, spring production surplus that could not be filleted immediately was sold at a lower price; fishermen received average of lower and higher prices.

In 1969, Lake Erie fishermen harvested a record catch of nearly 30 million pounds worth C$3.2 million.

The Fisheries Prices Support Board is expected to recover cost of program later in the year. Processors selling fillets to Board during peak production periods undertake to buy back at cost all products in the program.

* * *

CONFERENCE ON CANADIAN SHRIMP FISHERY SLATED FOR OCT. 1970

The firm establishment of a prosperous shrimp fishery in Canada's Atlantic Coast provinces is the main objective of a conference to be held in Fredericton, N.B., Oct. 27-29, 1970. The three-day meeting will encourage development of a new fishery.

During past years, Federal and provincial explorations showed that commercial quantities of pink shrimp, Pandalus borealis, are present in the Gulf of St. Lawrence; comparatively small-scale fishing has supported prospects of profitable operations.

The Conference Agenda

At the conference, specialists from Canada and other countries will focus on successful catching and processing methods outside of Canada. Governmental and other experts will outline possibilities indicated by exploration work findings and discuss future plans. Quality control, storage, and marketing also will be discussed.

Pink Shrimp Fishery

The pink shrimp is smaller than Gulf of Mexico shrimp; it has a ready market in U.S. and Europe. There has been a limited fishery in Quebec in recent years and, for the past two years, in Bay of Fundy. There, 37 new Brunswick draggers landed about 2 million pounds in 1969. Most of catch was cooked before being landed for further processing at five shore-based plants.

Besides Gulf of St. Lawrence, good possibilities are reported from southwest coast of Nova Scotia, and off Newfoundland.

The Canadian Department of Fisheries and Forestry, in cooperation with the provinces, is continuing shrimp explorations.

ST. PIERRE ET MIQUELON

EXPANSION CONTINUES

Major construction is planned to begin this summer as part of St. Pierre's plan to expand facilities to attract more fishing vessels. A new 450-ft. wharf will be built. (U.S. Consul, St. Johns, Mar. 18.)

EUROPE

NORWAY

STUDIES COSTS AND EARNINGS OF FISHING VESSELS

Since 1950, the Norwegian Directorate of Fisheries has carried out annual costs and earnings investigations based on annual and seasonal accounts submitted by debtors of the State Fisheries Bank. This was reported on Feb. 12 by 'Fiskets Gang', a Directorate publication. The investigation covers fishing vessels 40 to 169 feet long (except trawlers more than 200 GRT) fishing for at least 30 weeks in 1967.

The Findings

The investigation shows increasing gross earnings with increasing size of vessels; on average, these range from about US$14,500 for vessels between 40 and 50 feet (South Norway) up to $246,000 for vessels above 120 feet (South Norway). Operating costs and depreciation increased correspondingly from $6,000 to $131,000.

Average Surplus

The average surplus on vessel and gear to the owner varied from minus $1,500 for vessels 80 to 100 feet (South Norway) to $19,700 in biggest size group (above 120 feet in South Norway). The three largest groups, IV, V, and VI in both South and North Norway, are dominated by herring purse seiners.

Wages

The average wage earning capacity per man-week varied from $47 to $139. This is gross earnings minus aggregate operating costs, depreciation, and calculated interest on capital. Except for vessels 40 to 50 feet, there was a covariation between wage-earning capacity per man-week and vessel size. But covariation was less clear than in 1966.

Fisherman's Annual Share

Also, fisherman's annual share increased with vessel size, except for vessels 40 to 50 feet. In 1967, fisherman's annual share varied on an average from $2,300 to $5,600. The fisherman's annual share is defined as share attained for a whole year's work. It is purely a work share; capital surplus is not included.

Rate of Capital Surplus

The rate of capital surplus, which is the amount of capital surplus as percentage of the market value of the capital employed, varied substantially--from minus 1 to plus 18% for vessels under 100 feet, and between plus 1 and 9 for vessels above 100 feet.

The vessels under study had been occupied in a variety of seasonal fisheries with highly varying economic results during the year. The average economic results of the vessels decreased considerably from 1966 to 1967 in majority of size groups.

For the most part, average wage-earning capacity too decreased from 1966 to 1967.

* * *

SEES U.S. AS GROWING MARKET FOR FROZEN FISH

Frozen-fish exports from Norway to all markets was about 117,000 tons in 1969, a substantial rise above 1968. Sales were handled by Frionor, Findus, and the Nordic Group.

The U.S. is a growing market. During 1967, only 7,000 metric tons were exported; in 1969, 42,000 tons: 30,000 tons produced by Frionor, one of world's largest exporters of these products, and 12,000 tons by Nordic Group, also firmly established in this highly important market.

Nordic Uses Other Trademarks

The Nordic Group has not sold its products under its own trademark. In most cases, the trademark of First National Stores (Finast) is used, but the frozen fish fillets are also sold under other private labels.

Main Items Researched

The main products are skinless and boneless fillets of cod and haddock. The items result from intensive market research by Nordic Group experts. U.S. preferences in taste, appearance, and packaging were examined thoroughly. The products marketed through First National Stores have proved very successful.

NORWAY (Contd.):

Nordic Group is joint export organization for 21 freezing plants, headquartered in Trondheim. ('Norwegian American Commerce', Jan.-Feb. 1970.)

WEST GERMANY

HERRING FISHERY OFF U.S. & CANADA GROWS STRONGER

The manager of a Norwegian herring fishery off Canada (Carino Company, Ltd.) has described to his firm the operation of West German factory vessels in the Western Atlantic:

There are 24 large factory vessels, 84 meters long, 3,200 h.p., with daily freezing capacity of about 50 metric tons a day. The vessels have up-to-date equipment to fillet herring and other fish. They use both a bottom and pelagic trawl guided by latest electronic gear. Eight pelagic trawls are carried on board each vessel of 4 different types. The factory vessels use St. Pierre as home base for repairs and transfer of catch and crew. Aboard each vessel are 60-70 men serving 7-month hitches. They choose their vacation time on three months' notice.

Mostly Cod Fishing

The fleet goes to Greenland from February to May to fish mostly cod. It uses a bottom trawl. The 1969 fillet production was about 2,000 metric tons per vessel.

Herring Fillets

After reloading and repairs in St. Pierre, the vessels sail to the banks outside Nova Scotia and to Georges Bank in June to fish herring with a pelagic trawl. They fish in the Gulf of Maine and elsewhere up to U.S. 12-mile limit. About 1,500 tons of herring fillets were packed from June to August, in addition to herring meal and oil. From mid-September to Christmas, "Vollherring" (herring without heads, frozen in the round) is produced. The captains estimated they could produce easily 2,000 tons per boat, which would yield annually 5,500 tons of frozen products, plus meal and oil.

20% Herring Fillets Salted

The Germans long ago stopped salting round herring from Georges Bank because they were unable to obtain acceptable quality with methods used. They now salt about 20% of herring fillets and have no problem achieving excellent quality.

Double Trawler Size

From a very small start in North Sea and Iceland, where they used reconstructed fresh fish trawlers, they have doubled size of giant trawlers. During last three years, they have been in full operation with floating trawls for herring.

Germans Outfished Norwegians

In 1969, the Norwegian factoryships that fished during same period and area produced 100 tons of herring fillets; the Germans produced 750 tons. This may show that more gear and equipment experience is needed than that with which Norwegians began.

Compared to bottom trawling, it appears pelagic trawl requires more powerful motors and winches. The vessel must be capable of changing trawl type according to conditions and be manned by experienced crew knowing the techniques. (Reg. Fisheries Attaché, Copenhagen, Mar. 24.)

* * *

MARKET FOR HERRING AND MACKEREL

The Norwegian Fisheries Attaché in Hamburg recently advised the Norwegian industry to pay more attention to W. German market for herring and mackerel. He reported:

West Germany is still the largest importer of fish and fishery products, after U.S. and Great Britain. In 1968, Germany's total consumption of fresh-frozen herring was about 250,000 metric tons (catch weight). Her own production reached top in 1965: catch weight of 774,000 tons, of which 40% was herring. Since then, however, North Sea fishery declined.

Herring Stock Decline

The decline in herring stocks produced large deficit in supply. Denmark took over

WEST GERMANY (Contd.):

more and more of market. To compensate for this, the German fleet looked for new herring grounds. During recent years, it succeeded in fishing herring on Georges Bank in Atlantic off U.S.

The 1967 production of frozen herring and herring fillets reached about 19,000 tons. In 1968, number of herring fillets 32,000 tons; round herring was 5,500 tons.

The number of W. German factory vessels in Georges Bank fishery was 18 during 1958, and more in 1969. W. German scientists fear that Georges Bank herring is being overexploited and that supplies from there will be reduced.

Denmark Is Main Supplier

It is questionable, however, whether German vessel owners will be able to cover expenses during 1970. Denmark has strengthened position as main supplier of herring to West Germany. Germany's imports from Denmark were 120,514 tons, or about 73% of herring imports.

Norway's share of German imports during 1968 was 11,385 tons, about 7.5%. Her exports of fresh round herring to Denmark in 1967 was considerable; the herring were filleted and reexported to West Germany.

Obtaining Enough Herring Difficult

West Germany's demand for raw material in catch weight (in addition to salted herring) is about 250,000 tons; of these 80,000 is used in canned products, 95,000 tons for marinated products, and remainder for smoking, fresh fish, and other purposes. The possibility of obtaining sufficient herring for all those purposes is limited.

If North Sea herring fishing declines further, unexpected possibilities might open for frozen mackerel fillets to W. German canning industry in future years. Mackerel consumption now is about 6,000 tons a year.

The Future

In 1968, German imports of fresh mackerel were about 2,500 tons: 280 tons from Norway and about 1,740 tons from Denmark. Expanded ferry connections in recent years between Norway and W. Germany should enable Norway to increase her share of fresh mackerel market.

Majority of mackerel is for smoking; a smaller part for canned products. Good possibilities exist to increase use of mackerel fillets for canning because several W. German canning factories fear insufficient herring supplies. They believe they must introduce new products from other fish. (Reg. Fish. Attaché, Copenhagen, Mar. 24.)

UNITED KINGDOM

TO ABANDON FATHOM MEASUREMENT

The British Government has asked Parliament to authorize use of the metric system aboard ships as part of a general move toward that system. The fathom, an ancient nautical measure for 6 feet (0.914 of a meter), will be replaced by the meter. ('New York Times,' Feb. 26.)

The tradition-weighed British Navy is last to bow to the inevitable. Bankers were first: British pounds were converted to the decimal system.

USSR

WORRY ABOUT LAKE BAIKAL FISHERY RESOURCES

Fifteen years of overfishing have so decreased the omul, or fresh-water whitefish ('Coregonus autumnalis migratorius'), resource on Lake Baikal that Soviet scientists believe it will take about 7 years to restore it to commercial level. Omul is one of the most important fisheries in Lake Baikal. To improve the situation, Soviet Fisheries Minister Ishkov, May 1969, banned commercial and sports fishing of omul, sig, a species of whitefish found only in Lake Baikal, 'C. lavaretus baicalensis', and sturgeon.

1970-75 Plans

According to chairman of Siberian Branch of Ministry's Ichthyological Commission, new omul hatcheries will be built and existing ones

USSR (Contd.):

expanded in Baikal area between 1970-1975. A "new" reproduction technique will be introduced: part of spawning omul will be allowed to spawn naturally; the rest will be harvested for artificial reproduction. After ban is lifted, omul will be caught only in the rivers where it migrates, but not in Lake Baikal. This will eliminate fishing fleets and save manpower and gear. ('Vostochno-Sibirskaia Pravda')

Controversy Over Baikal Pollution

Soviet concern about Lake Baikal was expressed too in a motion picture centering on 12-year-old controversy between conservationists and industry managers. The lake's fauna is threatened by pollution from wood pulp factories on its shores. The motion picture is pessimistic: there are no signs of improvement. ('New York Times,' Mar. 2.)

POLAND

ESTABLISHES EXCLUSIVE FISHING ZONE

Poland has established an exclusive fishing zone along her Baltic coast. It extends 12 nautical miles from the base line used to determine her 3-mile territorial waters.

Vessels of countries traditionally fishing in the 6-12 mile zone, and in the 3-6 mile zone, will be allowed to continue fishing; the latter on a temporary, transitional basis. In both cases, however, the countries must negotiate bilateral agreements with Poland in order to fish after January 1, 1971. (U.S. Embassy, Warsaw, Feb. 19.)

* * *

PLANS INCREASED CATCHES OF BALTIC SALMON

Under the 1970-1985 fisheries development plan, Poland plans catches of salmon species in the Baltic of 740 tons a year. Several programs have been devised: (1) conversion of drift-net materials from hemp to synthetic fibers; (2) training fishermen in modern salmon-catching techniques; (3) equipping nets with floats having radar reflectors; and (4) construction of prototype salmon cutter to begin a series of salmon-fishing vessels. Until now, most Polish Baltic salmon fishing has been done with 7-meter-long beach-type boats. Future salmon fishing will be conducted mostly by cooperative fishermen; private fishermen may continue their traditional fishery but will not be supported by the government.

Catches Fluctuated

Catches by all countries fishing in the Baltic fluctuated between 2,000 (1958) and 3,700 metric tons (1964). The 1966 catch of 2,907 tons was made mostly by Danes (1,659 tons). Poland landed only 116 tons in 1966; her catches never exceeded 350 tons (1964).

Salmon & Salmon-Trout

Salmon ('Salmo salar') are fished in winter and spring by Danish, Swedish, and German fishermen in the Southern Baltic, to which they migrate from Swedish waters.

The Poles have stocked salmon trout ('Salmo trutta') extensively, the second most important Baltic salmon-like species; it originates in Polish rivers. Two salmon-trout hatcheries have been built. ('Polish Maritime News')

HUNGARY

EXPANDS FISH-POND PRODUCTION

Hungary plans to increase production of pond fish to make more animal protein available at relatively low cost. The aim is to increase annual fish consumption to 5 kg. (11 lbs.) per person by 1980, in 1968; it was 2.55 kg. (5.6 lbs.).

Asks UN Help

To achieve this, Hungary has asked the United Nations Development Program (Special Fund) to help her improve research and training facilities in fish culture.

Hungary also is increasing production of grains required for fish feeding. ('World Food Program News,' Jan.-Feb. 1970.)

CZECHOSLOVAKIA

FISH CULTURE TRENDS

The first Czechoslovak experiments on carp culture in ponds fed with warm-water effluents from power plants were conducted in 1968-1969. Breeding was hastened by one month compared with normal pond conditions.

At water temperature of 25-30° C. (77-86° F.) and fed granulated feeds, 1 to 1+ year-old common carp in cages gained about 1,500 kilograms/hectare in 3 months; the average weight per fish at harvesting was 1 kilogram.

The research is aimed at achieving mass production of carp fingerlings.

Ducks & Carp

The university raised ducks for a short period to see whether this intensive fertilization would increase production of carp fry. Carp larvae were released into ponds after duck rearing ended. After 25 days, fry production was considerably more than in control ponds.

The university is now trying to increase production of carp yearlings through optimum combination of fertilization, feeding, and population density. ('FAO Fish Culture Bulletin')

ICELAND

CAPELIN FISHING SEASON LOOKS GOOD

As of mid-March, the capelin catch totaled 110,000 metric tons. Already, 1970 is Iceland's third best capelin year (1969: 171,000 and 1966: 125,000 tons).

Several weeks of fishing remained before season ended (traditionally early April).

Capelin is used exclusively for fish meal and oil. (U.S. Embassy, Reykjavik, Mar. 17.)

EAST GERMANS & SOVIETS

COOPERATE IN APPLYING COMPUTER TECHNOLOGY TO FISHERIES

A conference between Soviet and East German computer specialists in Rostock (E. Germany) last year concerned problems of computer techniques applied to fisheries. Joint research is aimed at improving control of fishing-vessel operations and devising mathematical and arithmetical models for shipboard computers. Models for tactical and strategic fishing control also are being studied.

The Soviets and E. Germans would like to solve at sea: general economic data analysis (without computers); optimum correlation between catch, production, and processing capability of vessels; optimum deployment of vessels (by mathematical programming and games theory).

Marine Biological Research

The 2 countries also plan to apply mathematical methods and computers to marine biological research: devise mathematical models to forecast yields and catch, design experimental population dynamics models to determine stocks of individual species, and to forecast commercial fish concentrations from biotic and abiotic factors.

The 2 parties are developing a unified system of collecting, storing, and exchanging commercial fishery data according to a unified mathematical processing technique. They also are developing standard symbols for block diagrams and information processing, as well as a standard computer language. ('Rybnoe Khoziaistvo,' 1969.)

System to Control Whole Fleet

The Soviet Caspian Fisheries Administration installed data-processing computer in August 1969. The Soviet Fisheries Ministry is working on an automatic data-control system that will make it possible to control the operations of the entire Soviet fishing fleet.

LATIN AMERICA

PERU

FISH-MEAL PRODUCTION & EXPORTS DECLINED IN 1969

In 1969, fish meal supplies in Peru--world's major supplier and leading competitor for U.S. exports of soybean meal--declined 519,700 metric tons. This equaled crude protein content of 35.9 million bushels of soybeans. The decline produced sharp increase in prices and exports fell 427,600 tons--equal to 29.5 million bushels of soybeans.

In 1969, supplies were 2 million tons and exports 1.7 million tons.

Last 4 Months Crucial

In 1969, 257,700 tons (83% of decline in production) and 389,600 tons (91% of decline in exports) occurred in last 4 months of fishing season, which began Sept. 1, 1969; it reflected reduced catches of anchovy.

Stocks during 1969 dwindled from over 490,000 tons on May 1 to less than 50,000 tons on Sept. 1.

Prices Rose

In 1969, average monthly prices--cost, insurance, freight (c.i.f.) European ports--rose sharply from low of about $137 a metric ton in January to nearly $228 a ton in November. The 1969 annual average price of $177 a ton was markedly above 1968's $134 average, the highest since 1966.

Prices have declined significantly since Jan. 1970 as catch improved and stocks increased. On March 5, prices were $175 a ton.

8.5 Million Metric Tons

Virtually all of Peru's fish meal is produced from anchovies, which are subject to seasonal catch limits. The 1969/70 fishing season quota is 8.5 million metric tons; last season's was 10 million tons. If achieved, it could produce 1.6 million tons of meal.

Exports to U.S. & Canada Fell

Exports to U.S. and Canada declined 361,400 tons in 1969; this is crude protein equivalent of 25 million bushels of soybeans. This decline and reduced exports to other Western Hemisphere nations accounted for 96% of total decline.

Peru's Fish Meal Exports

	1968		1969	
United States and Canada	550.9	26.4	189.5	11.4
South America	143.4	6.9	103.7	6.3
West Germany	396.9	19.1	384.2	23.2
Other Western Europe	556.0	26.7	595.5	36.0
Eastern Europe	278.1	13.3	267.5	16.2
Japan and all others	157.9	7.6	115.2	6.9
Total	2,083.2	100.0	1,655.6	100.0
Total exports excluding those to Western Hemisphere	1,388.9	66.7	1,362.4	82.3

Exports to Europe Up

Exports to Europe totaled 1.25 million tons, slightly above 1968. West Germany emerged as largest market: 384,200 tons, or over 23% of all Peruvian exports; in 1968, 396,900 tons (18%). West German imports are expected to decline significantly this year; her recent changes in mixed-feed regulations will accentuate import decline. ('Foreign Agriculture,' U.S. Dept. Agric., Mar. 30.)

* * *

FISH MEAL FUTURES UP

Fish meal futures prices have increased sharply, said the 'Wall St. Journal' on April 21. New York fish meal futures prices rose $5 a metric ton, the daily limit. The May 1970 contract was quoted at $205.50. In Hamburg, Germany, fish meal prices rocketed $18 a ton. Supplies for April-June delivery were tagged there at $208, and for July-December shipment at $213.

Demand was sparked by reports that the Peruvian Government has prohibited all further sales of the high-protein livestock and animal feed. According to private sources in Peru, the Government will take over completely the marketing of fish meal.

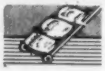
Action Expected

Apparently, the Peruvian fishing industry and foreign buyers expected the action. As a result, about 750,000 tons were sold for export prior to the ban.

PERU (Contd.):

Some supplies sold for export already have been shipped. Some will be taken from reserve stocks; on April 1, these amounted to 444,000 tons. A year earlier, the stock was 450,000 tons.

Export orders call for shipments as far ahead as December 1970. It is understood Peru will allow shippers to take supplies from new production without any defaults.



MEXICO

FISH PRODUCTION WAS ONLY ECONOMIC SECTOR TO DECLINE IN 1969

Mexico's 1969 fish production was 232,701 metric tons, a drop of 3.1% from 1968. These were preliminary data from Secretary of Industry and Commerce.

Thus, for second consecutive year, fishing was only economic sector to decline.

Ups & Downs

Continuing the trend begun in 1967, shrimp production in 1969 of 32,056 metric tons was a drop of another 11.1%. Anchovy output fell 72.8%. There were gains in oysters (31.7%), grouper (30.4%), and spiny lobsters (up 116.7%).

In industrial products, fish-meal production gained 30.2%, continuing upward trend of recent years and moving toward goal of self-sufficiency in fish meal.

Shrimp No. 4 Export

Shrimp exports in 1969 were worth US$51.8 million, down 4.2%. This was a smaller decline than in 1968. It is explained by generally higher prices in the U.S., which took most of these exports.

Because of high prices, shrimp remained No. 4 in exports after cotton, sugar, and coffee. (Reg. Fish. Attache', U.S. Embassy, Mex., Apr. 11.)

CUBA

BUYS ITALIAN-BUILT REFRIGERATED FISH CARRIER-MOTHERSHIPS

Cuba has acquired 2 sister carrier-motherships, 'Oceano Pacifico' and 'Oceano Indico'. Built in La Spezia, they are the largest, fastest, most modern and best-equipped vessels of Cuba's high-seas fishing fleet (Flota Cubana de Pesca). In November 1969, vessels were transporting catches from trawlers and tuna fishing vessels in Atlantic. Oceano Pacifico was deployed off Equatorial Africa.

The Vessels

The vessels are: 6,651 GRT; length overall 140.5 meters; breadth 17.8 meters; 10,500-hp. engine; cruising speed 20 knots an hour fully loaded. Eight have refrigerated holds and have a total capacity of 8,350 cubic meters. Temperatures of holds can be thermostatically controlled down to -20° C. (-4° F.).

Equipment

Equipment includes radar (48-mile range), automatic pilot, radiogoniometer (direction finder), echo-sounder (range to 300 fathoms), 1-kilowatt transmitter, and an automatic alarm system. Crew's quarters, with dining, living, study and recreation rooms, are said to "resemble hotel accommodations." ("Granma")

PANAMA

FISHERY PRODUCTS WERE 10.6% OF ALL EXPORTS

Panama's fishery exports (fish meal and shrimp) were 10.6% of total exports during Apr.-Sept. 1969.

Total shrimp exports were 2,440 metric tons worth US$5.6 million; fish meal exports were 1,569 metric tons worth US$202,000. (U.S. Embassy, Panama, Mar. 17.)

ASIA

JAPAN

TUNA FLEET SIZE DECLINES BUT GROSS TONNAGE RISES

In 1969, the gross tonnage of large Japanese tuna vessels over 300 tons, and of motherships, declined about 7,000 tons from 1968. The tonnage of vessels in the 210-300-ton category increased. ('Suisan Tsushin,' Mar. 10.)

Tuna Fleet 1968-69

Vessel Size	1969 No. Vessels	1969 Gross Tons	1968 No. Vessels	1968 Gross Tons
Vessels Engaged Exclusively in Tuna Fishery				
Under 120	240	24,435	318	31,865
120-210	285	53,197	263	48,450
210-300	435	115,950	381	100,464
Over 300	201	78,327	203	79,891
	1,161	271,909	1,165	260,670
Vessels Engaged Seasonally				
	122	11,023	125	11,002
Distant-water Motherships				
Motherships	35	34,633	37	39,898
Portable boats[1/]	70		86	
Vessels Engaged in Coastal Tuna Fishery				
	1,634	71,234	1,671	69,082
Grand Total[1/]	2,952	388,799	2,998	380,652

1/Portable boats carried by motherships are not included in grand total.
Source: Second Ocean Section, Fisheries Agency.

* * *

ONLY YELLOWFIN TUNA SEINER IN E. PACIFIC FAILS AGAIN

After losing her skiff, the 500-gross-ton 'Hakuryu Maru No. 55', Japan's only seiner in the 1970 eastern Pacific yellowfin tuna fishery, sailed for home. She began fishing in early January and had landed a disappointing 100 tons of yellowfin. It was her second unsuccessful try in the eastern Pacific purse-seine fishery.

She'll Try Again in 1971

In 1969, she and 3 other Japanese seiners experienced a disastrous failure in that fishery. The Hakuryu Maru is scheduled to undergo extensive gear modifications in preparation for a third try next year. ('Suisan Tsushin,' Mar. 27.)

* * *

TUNA LONGLINE CATCH RATE IS DECLINING

The hook rate in the tuna longline fishery during 1969 generally declined from 1968. This was reported by the Japan National Federation of Tuna Fishery Cooperative Associations (NIKKATSUREN).

Its study was based on 100,000 sets, or about 6 months' longline fishing effort.

Catches in 3 Oceans

The catch per set in 1969 was 1.7 metric tons in the Pacific; 2.2 tons in Atlantic; and 1.6 tons in Indian Ocean. The 1969 catch per set in Pacific was about 1968 level, but in the Atlantic and Indian Oceans the rate was 20-30% below 1968.

The outlook for 1970 is that longline catch may decline further. It is believed that tuna landings have declined in proportion to increase in fishing effort of South Korean and Taiwanese fleets. ('Minato Shimbun,' Mar. 12.)

* * *

VESSEL COMPLETES TUNA SURVEY IN SOUTH ATLANTIC

The Japanese tuna longliner 'Azuma Maru No. 37' (314 gross tons) returned to Tokyo on Mar. 15, 1970, after an 11-month government-subsidized, tuna-resource survey in the South Atlantic.

The vessel caught 311 metric tons of fish: 37% albacore, 27% big-eyed, 24% swordfish, 15 tons southern bluefin (400 fish), and others.

Best Fishing Grounds

The best fishing grounds were near 35° S. latitude and 45° W. longitude, where good big-eyed catches were made. Swordfish were taken near 36° S.-37° S. latitudes and 50° W.-52° W. longitudes.

Blackfin Tuna Caught

The catch also included 2-3 tons of Atlantic blackfin tuna, which contain much oil and are likely to bring good price on Japanese fresh-fish market.

JAPAN (Contd.):

Another Cruise

In April, the Azuma Maru was scheduled to depart on another cruise, for which the Government budgeted about $177,800. ('Katsuo-maguro Tsushin,' Mar. 17.)

* * *

TO INCREASE SKIPJACK TUNA FISHING EFFORT

The Japanese Fisheries Agency is focusing on development of skipjack tuna resources. It is developing survey plans. Despite opinion of some scientists that there is an overabundance of skipjack, the annual catch is only around 200,000 metric tons.

1969 Catch 20.3 Billion Lbs.

The greater Japanese catch in 1969--20.3 billion pounds--was due primarily to increased landings of Alaska pollock. But the pollock catch cannot be expected to continue increasing, so the Agency is eyeing skipjack to boost production further. Exploratory purse-seine cruises are being scheduled for this year in the southwest Pacific north of New Zealand, and in the mid-eastern Pacific. About US$861,000 has been allocated for fiscal year 1970 (April 1970-March 1971).

The Agency is considering initial surveys off Palau (U.S. Trust Territory of the Pacific) and off northwest Australia. ('Shin Suisan Shimbun Sokuho,' Mar. 10.)

* * *

EXPECT IMPROVEMENT IN SHRIMP MARKET, IMPORTS DOWN

Japanese imports of frozen shrimp in 1969 reached a record of nearly 49,000 metric tons, although the domestic shrimp market continued sluggish. Since Jan. 1, 1970, the market has shown signs of recovering; cold-storage holdings have decreased gradually. However, since the shrimp situation in Japan has not yet stabilized, the trade journal 'Suisan Keizai Shimbun' polled about 30 major firms on the present state and outlook for the shrimp business.

Survey Results

The responses generally were:

(1) No sharp uptrend in market conditions during first 6 months but, in view of present firm movement, market should improve gradually; (2) the quantity of shrimp imports depends on price, among other factors, but optimum level is around 40,000-45,000 metric tons a year; (3) promising shrimp grounds are off southeast Asian countries (Philippines and Indonesia), and off west Africa; and (4) consumer pack is an effective way to increase demand, and packing product at source of supply is preferable to repacking in Japan.

Imports Down

Japanese imports of frozen shrimp during January 1970 totaled 3,113 metric tons valued at about US$7.94 million, down sharply from Dec. 1969 imports of 4,306 metric tons worth $11.1 million. Jan. 1970 imports were contracted during Nov. and Dec. 1969, when the Japanese market was weak. ('Suisancho Nippo,' Feb. 17 & 28.)

* * *

SALMON FISHING IN JAPAN SEA STARTED MARCH 1

Japanese salmon fishing in the Japan Sea started on March 1. This fishery and the North Pacific salmon fishery are controlled by the Japan-USSR Northwest Pacific Fisheries Convention. Vessels must report location and catch each day to patrol boats of Japanese Fisheries Agency.

Large Fleet Operates

About 760 vessels from eight Japanese prefectures were expected to operate. This leads to complications in radio communication. In 1970, at least three radio bands will be used to ease communications problems. ('Minato Shimbun,' Feb. 25.)

* * *

TRAWL FLEETS LEAVE FOR EASTERN BERING SEA

Three trawl fleets departed Japan in late February for the eastern Bering Sea to produce minced fish meat (surimi), fish meal, frozen fish, and fish oil and solubles. The fleet is expected to operate there until late September. ('Suisancho Nippo,' Feb. 23.)

Their production plans are:

Fleet	Surimi	Meal	Frozen Fish	Oil	Solubles
			(Metric Tons)		
'Gyokuei Maru'	7,000	22,000	1,500	2,000	0
'Mineshima Maru'	15,000	20,000	6,500	1,800	2,000
'Shikishima Maru'	15,000	15,000	3,000	1,400	0
Total	37,000	57,000	11,000	5,200	2,000

THAILAND

BANGKOK UNIVERSITY TRAINS
LAOTIAN FISH-CULTURE SPECIALISTS

Since 1967, the College of Fisheries of Kasetsart Unversity, Bangkok, Thailand, has been training Laotians in fish culture under a program sponsored by U.S. Operations Mission (USOM) in Thailand.

So far, 16 Laotians have received 4 weeks' training, and participated in study tours and field work under the guidance of Thailand's Department of Fisheries.

3 Fish-Culture Stations

Three fish-culture stations were established in Laos in 1966--in Vientiane, Luangpravang, and Pakse Provinces. They have successfully bred the common carp introduced from Thailand. Fingerlings are distributed to interested farmers. There is now considerable interest among farmers to culture fish.

By 1971, the 3 stations may produce annually 2.8 million fingerlings and 65 to 70 tons of edible fish. (FAO Fish Culture Bulletin')

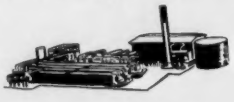
TAIWAN

MARINE FISH-CULTURE
LABORATORY BUILT

A marine fish-culture laboratory has been erected at Tungkang in southern Taiwan under a research project financed by the Rockefeller Foundation. The buildings include a research laboratory, storage building, and a dormitory. Concrete ponds with circulating sea water are under construction.

Shrimp & Grey Mullet

The work of the laboratory is directed mainly toward the biology and culture of shrimp, and the induced spawning of grey mullet, Mugil cephalus. ('FAO Fish Culture Bulletin')



SOUTH VIETNAM

SAIGON FISH MARKET IN OPERATION

The recently opened Saigon Fish Market is Vietnam's newest and largest wholesale fish-marketing facility. Built with U.S. funds, the modern US$2,360,000 structure will help reorganize South Vietnam's traditional fish-marketing system.

The Fish Market

The complex consists of a landing wharf, market building, offices, cold-storage rooms, and paved approach roads. About $65,000 additional funds were used for a parking area and supplementary facilities. (U.S. Embassy, Saigon, Feb. 14.)

SOUTH KOREA

DEEP-SEA FLEET SHOWS
STRONG GROWTH

The deep-sea fishing fleet of the Republic of Korea (South Korea), though increasing steadily over the past few years, suffered a small setback during second half of 1969. On July 1, 1969, it included 209 vessels (over 63,000 gross tons). By Jan. 1, 1970, only 1 vessel had been added, but total gross tonnage had decreased to 56,600 tons. Net gain for 1969 was 20 vessels (10,300 gross tons), a growth rate of 22%, one of the world's fastest.

1 Firm Liquidated

Much of the decrease between July and December 1969 was due to the liquidation of the Shin Hung Fisheries Company. The company had entered 17 vessels (13,560 tons) in Northeast Pacific high-seas fishing in summer 1969. Apparently operations were financially unsuccessful and the company, with no vessels in January 1970, merged with Sam Yang Company.

SOUTH PACIFIC

AUSTRALIA

SHRIMP CATCH ROSE IN 1969

The 1969 shrimp catch by trawlers in northern Australia has been estimated at 9.5 million lbs., live weight--more than double 1968's 4.5 million lbs. The official 1969 total could reach 10 million lbs. The record catch was made by 350 trawlers--100 more than in 1968.

Northern Territory

Production in Northern Territory is now emerging as one of Australia's major shrimp fishing areas; 3 trawlers took an estimated 7 million lbs., compared with only 200,000 lbs. in 1968.

Arafura Sea Most Productive

International waters in Arafura Sea, the most productive grounds, yielded 2.4 million lbs. of shrimp. Trawlers in Arnhemland-Gove area caught 2 million lbs.; in Melville Island grounds, 1.3 million lbs.

Queensland

Queensland grounds north of Townsville and in the Gulf of Carpentaria produced 2.5 million lbs. (1.5 million lbs. from Karumba-Weipa area in Gulf). In 1968, these eastern Gulf grounds produced 4.4 million lbs.

Species

Of 9.5 million lbs. of shrimp caught in northern Australia in 1969, 7.1 million lbs. were 'bananas', 1.4 million lbs. 'tigers', and 500,000 lbs. 'endeavours'.

Dec.-Jan. Fall Off

During December and January, catches by northern trawlers dropped off. Many boats were laid up for overhaul to prepare for 1970 season expected in March.

Above-average rain, particularly in Darwin-Cape York Peninsula coastal strip, has raised hopes of good 1970 season in Gulf of Carpentaria.

Northern Territory Activity

In Northern Territory, 60-70 trawlers were expected to operate. Three shore-based factories have been established--at Groote Eylandt, Katherine, and Darwin. Construction of a fourth new processing plant at Darwin, in advanced state, is for joint Australian-Japanese enterprise.

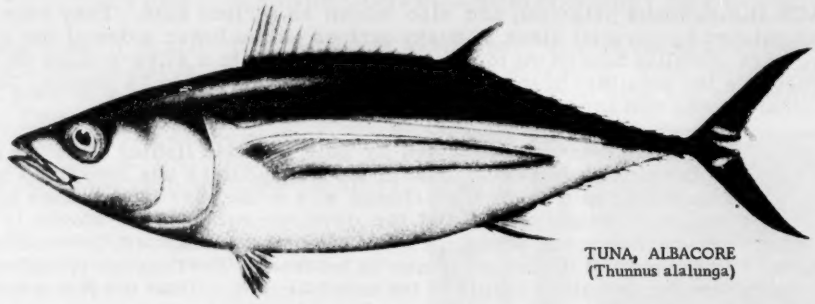
This company has four 70-ft. trawlers under construction in Australia and expected to be delivered in this season.

Seven fishing companies (three joint ventures) will be operating fleets in waters adjacent to Northern Territory and in international waters.

Queensland East Coast

On Queensland east coast, trawlers were waiting in late January for wet season to end before proceeding to shrimp grounds in north and in Gulf of Carpentaria. ('Australian Fisheries,' Feb. 1970.)

FOOD FISH FACTS



TUNA, ALBACORE
(Thunnus alalunga)

Tuna, one of mankind's most ancient and honored foods, were pursued by fishermen hundreds of years before the time of Christ. Ancient Greeks referred to tuna as "thunnos" and they had an intense taste and admiration for these fish. Their admiration was evidenced in verse and decorating themes of that era.

In the still undiscovered New World, ancient Incas and other civilizations were also harvesting tuna along the coasts of Peru and other South American coasts along the Pacific Ocean. Their two-man reed boats, used in searching for tuna, were almost unsinkable.

In the United States, over a billion cans of tuna are consumed annually.

DESCRIPTION AND HABITAT: There are four kinds of tuna: albacore, yellowfin, bluefin, and skipjack. All four belong to a large family of fish which includes the mackerels and bonitos. The members of this family are similar in that they travel in schools and are among the most rapid swimmers of all fish. Nautical engineers have described the contours of these fish as being perfect for passage through the water with the least resistance. The bodies are streamlined and smooth, and the fins, set in grooves on the bodies, offer little resistance as the fish glide through the water.

ALBACORE (Thunnus alalunga), vary from other tuna in flavor and in the whiteness of the flesh. They are also known as "longfins" and can be recognized by long, sabre-sharp pectoral fins. They are further distinguished by the metallic steely-blue color on the tops and sides of the body and a silvery color on the bottom side, as well as by the absence of stripes. The usual weight of albacore is between 10 and 60 pounds; however, the maximum recorded weight is 93 pounds. Albacore range from Southern California to mid-Mexican waters, sometimes going as far north as Puget Sound in the late summer.

YELLOWFIN (Thunnus albacares), probably the favorite of the tuna fishing fleet, are light-fleshed. They are considered one of the most commercially valuable of the four, and are also popular as game fish. Yellowfin describes these fish as they are distinguished by elongated, yellowish dorsal and anal fins, and yellowish coloring on the sides. They vary in weight from 30 to 150 pounds; however, fish from 40 to 100 pounds are considered choicest for canning. Yellowfin tuna are found from the Gulf of California south to the waters off northern Chile.

BLUEFIN (Thunnus thynnus), sometimes called horse mackerel, have light flesh and vary in commercial weight from 15 to 80 pounds. Bluefin tuna have a history as a game fish that goes back to Greek and Roman times. They are distinguished by the deep blue or green color on the tops and sides of the body. Unlike most fishes, the high metabolic rate of the bluefin tuna maintains a body temperature warmer than the water. Bluefin are found from Alaska to lower California; however, this species is sometimes found in the Atlantic Ocean.

(Continued following page)

SKIPJACK (Katsuwonus pelamis), are also known as striped tuna. They have light flesh and are distinguished by parallel black to dusky stripes on the lower sides of the body. Skipjack tuna are dark metallic blue on the tops and sides, shading to a silvery color on the bottom surfaces. They are the smallest of the four tunas, weighing from 4 to 24 pounds. Skipjack are found in tropical waters similar to the yellowfin.

Fishing for Tuna: At one time tuna were taken by pole and line fishing from the famed tuna clippers. Now, however, most of the tuna industry has converted to the more efficient purse seines. This change was made possible because of the introduction of nylon seines and the development of power blocks to handle the great nets. Purse seining has many advantages; the voyages are shorter, the need for bait has been eliminated, and the hazard to the fishermen is lessened. The tuna are transferred to refrigerated holds where immediate freezing of the catch occurs. Thus the fish are fresh upon reaching the canning and processing plants.

Conservation: In the early 1960's it became apparent that the stocks of Pacific yellowfin tuna had reached their maximum sustainable harvest. In 1966 this tuna came under effective regulation on the recommendation of the Inter-American Tropical Tuna Commission. An effort began to increase the harvest of underutilized species of tuna. Fortunately, the skipjack population and perhaps those of the temperate tunas appear not to be fully harvested. The Fishery-Oceanography Center of the Bureau of Commercial Fisheries, the IATTC, and other agencies are now involved in research designed to increase the take of these tunas through discovery of new fishing grounds, and increased knowledge of the week-to-week movements of the fish.

Uses of Tuna: Tuna supplies a rich source of protein, vitamins, and minerals. It is easily digested, and can be used as it comes from the can or combined with other foods. It is economical because there is no waste in the compactly packed and compressed cans. Although the packs are labeled white meat or light meat, they can be used interchangeably. It is available in solid-pack, chunk-style, or grated; and comes in $3\frac{1}{4}$ to $3\frac{1}{2}$, $6\frac{1}{2}$ to 7, $9\frac{1}{4}$, and $12\frac{1}{2}$ to 13 ounce cans.

(National Marketing Services Office, BCF, U.S. Dept. of the Interior, 100 E. Ohio St., Rm. 526, Chicago, Illinois 60611.)

TUNA -- CANNED CONVENIENCE FOR BUSY DAYS

Tuna does it again! That versatile performer, always ready and reasonable, stars again in a recipe that is just right for leisurely entertaining. Tuna, everybody's finny favorite, goes to a picnic or wears a party dress with equal ease and a minimum of effort. Crusty-Tuna-Bean Bake, a new Bureau of Commercial Fisheries recipe, spells good eating any time of year but is especially appropriate when the homemaker is short of time.

In this easy recipe, the tuna is blended with mushroom soup, bread crumbs, eggs, and onion to make a tuna crust. The green beans, plus pimiento and dill weed for flavoring variety, make the filling; and shredded cheddar cheese crowns the top. Baked in a moderate oven until thoroughly heated and the cheese is bubbly, this tasty casserole is ready to serve. This casserole may be prepared a day ahead and refrigerated until baking time.

Tuna is one of the greatest of all protein foods and also supplies vitamins and minerals in abundance. There is no waste in the compactly packed and compressed cans which assures 100 percent value to the consumer. The tuna industry had the homemaker's convenience in mind in choosing its three different pack styles. Solid-pack tuna is great for salads; chunk-style is just right for casseroles or skillet dishes; and grated or flaked tuna's small bits are ready for sandwiches or dips. Tuna is available in cans for individual servings (3¼ to 3½ ounces); enough for two 6½ to 7 ounces); medium-sized families (9¼ ounces); and larger families (12½ to 13 ounces).

CRUSTY TUNA-BEAN BAKE

- 4 cans (6½ or 7 ounces each) tuna
- 2 cans (10½ ounces each condensed cream of mushroom soup
- ⅔ cup dry bread crumbs
- ½ cup finely chopped onion
- 4 eggs, beaten
- ½ teaspoon salt
- ⅛ teaspoon pepper
- 2 packages (9 ounces each) frozen cut green beans
- ¼ cup diced pimiento
- ½ teaspoon dill weed
- ⅛ teaspoon pepper
- 1 cup shredded sharp cheddar cheese
- Paprika

Drain and flake tuna. Mix tuna with ½ cup soup, dry bread crumbs, onion, eggs, salt, and pepper. Line a well-greased baking dish, 13 by 9 by 2 inches, with tuna mixture letting the mixture extend up the sides of the dish. Cook beans according to directions on package, omitting butter or margarine. Combine beans, remaining soup, pimiento, dill weed, and pepper. Pour bean mixture into tuna lining and spread evenly. Place cheese around edge of bean mixture. Sprinkle cheese with paprika. Bake in a moderate oven 350° F., for 30 to 45 minutes. Makes 12 servings.

Tuna Cheesies, Tuna Nuggets, Tuna Puffs, and Tuna Tomato Teasers are just four of 26 tempting seafood recipes found in Nautical Notions For Nibbling, Fishery Market Development Series No. 10. For your copy, send 45¢ to the Superintendent of Documents, U.S. Government Printing Office, Washington, D.C. 20402.

(National Marketing Services Office, BCF, U.S. Department of the Interior, 100 East Ohio Street, Rm. 526, Chicago, Illinois 60611.)

BCF PUTS SNAP IN SNAPPER

Up until a few months ago, if Mrs. Housewife, U.S.A., wished to prepare red snapper for her table, she had to fillet or steak the fish in her kitchen. Although the fishing industry would have delighted in providing a ready-to-cook item, the fish would not cooperate. It seems that even with the best of care a few weeks of frozen storage would bring about a reaction in the flesh causing it to turn brown.

Fig. 1 - The distinctive red snapper, a popular gourmet fish throughout the U.S., is now available frozen through a new process developed by BCF technologists.

The BCF Technological Laboratory in Seattle was aware of this problem. If it could be solved, a tremendous new retail market for red snapper would be created. Snapper has long been known as a gourmet dish, such as baked red snapper with sour cream stuffing--or as quick-and-easy broiled fillet with lemon butter sauce.

The Research

The laboratory staff felt that the browning of the flesh was due to chemical processes taking place even at frozen storage temperature. In this day of new food-manufacturing processes, there are easily applied, safe additives that may be used to combat undesirable changes.

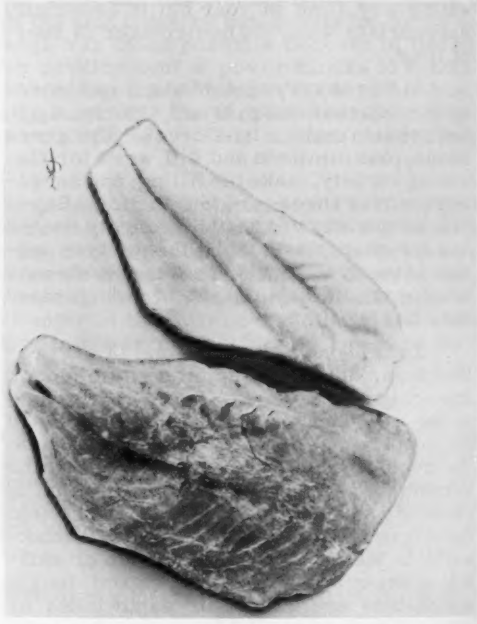


Fig. 2 - Two red snapper fillets were kept in storage for the same period of time. The smaller fillet was treated with the new BCF process; the larger fillet was not treated and shows oxidation and browning.

Sifting among the 20 or so available additives was a formidable task. Some were eliminated out of hand as not being at all useful or not suitable to the process. An even dozen were chosen as promising. These were applied either by dipping the fillet into a solution, or by injecting the fish with it. Also used were two methods of packaging the frozen product--a heavy glaze, or a package from which air could be eliminated entirely or replaced with an inert gas.

After two years of testing, the laboratory found a way of delaying or preventing the darkening of color. Dipping the fish fillets or steaks in a weak solution of TDP (thiodipropionic acid) and freezing in an air-free package would allow high-quality frozen storage for at least 12 months. The new product was taste-tested by 100 families and given an excellent report.

News of the breakthrough was communicated to the fishing community and food processors. Judging from the enthusiasm with which the process was greeted, we may expect to see ready-to-eat snapper in the frozen-food section of the retail market very soon. (Source: National Marketing Services Office, BCF, U. S. Department of the Interior, 100 East Ohio Street, Rm. 526, Chicago, Illinois 60611.)

SAVORY HALIBUT

North Pacific halibut has long been a favorite food for good eating. This largest member of the curious-looking flatfish family, and one of the tastiest of all fish, is taken along the continental shelf and slope of the North Pacific adjacent to Alaska, British Columbia, and Washington State. An excellent source of high-quality protein, vitamins, and minerals, halibut steaks are also a favorite with dieters because of the low sodium and fat content. The flesh is white, firm, and tender; and its mild satisfying flavor adapts readily to many preparation methods.

Savory Halibut, a BCF recipe, presents the halibut in a zippy, sour cream-green onion sauce with just a touch of basil. Topped with Parmesan cheese just before baking, the final touch is a few minutes under the broiler--just enough for the sour cream mixture and the cheese to turn golden brown and bubbly. This easily prepared recipe will be a favorite that you will want to serve often. Fortunately for halibut fanciers, North Pacific halibut steaks are available fresh or frozen the year round. So go ahead and indulge your fancy.

SAVORY HALIBUT

2 pounds halibut steaks, fresh or frozen
1 cup sour cream
½ cup sliced green onion
1 teaspoon salt
¼ teaspoon basil
¼ teaspoon white pepper
¼ cup grated Parmesan cheese

Thaw frozen steaks. Remove skin and bones and cut into 6 portions. Place fish in a single layer in a well-greased baking dish, 12 x 8 x 2 inches. Combine remaining ingredients except Parmesan cheese. Pour sauce over fish. Sprinkle with Parmesan cheese. Bake in a moderate oven, 350° F., for 20 to 25 minutes or until fish flake easily when tested with a fork. To brown, place fish in the broiler about 3 inches from source of heat and broil 4 to 5 minutes or until lightly browned and bubbly. Makes 6 servings.

Washington State has so many tasty fish and shellfish to share with the nation, we want to tell you about her brand new "Marine Fish Cookbook." The 39-page booklet has recipes for sole and flounder, rockfish, cod, sturgeon, albacore (tuna), smelt, and shad as well as halibut. The 9-page section on halibut contains recipes from the National Fishermen and Wives, Inc.--and who could know more about cooking halibut than the wife of a halibut fisherman? The book costs 50¢ and is available from the State of Washington Department of Fisheries, General Administration Building, Olympia, Washington 98501. A companion booklet, "Shellfish Cookbook," is available from the same source and the cost is 25¢.

(National Marketing Services Office, BCF U.S. Department of the Interior, 100 East Ohio St., Rm. 526, Chicago, Ill. 60611.)

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As the Nation's principal conservation agency, the Department of the Interior has basic responsibilities for water, fish, wildlife, mineral, land, park, and recreational resources. Indian and Territorial affairs are other major concerns of America's "Department of Natural Resources."

The Department works to assure the wisest choice in managing all our resources so each will make its full contribution to a better United States -- now and in the future.

BACK COVER: Maine sardines.
(R.K. Brigham)